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1220 WASHINGTON AVE., STATE CAMPUS, ALBANY, NEW YORK 12232

TECHNICAL REPORT 84-2

EVALUATION OF PENETRATING SEALING COMPOUNDS FOR USE AS BRIDGE DECK PROTECTIVE SYSTEMS

materials
bureau
technical
services
division

February 1984

-1(7/80)

TECHNICAL REPORT 84-2

EVALUATION OF PENETRATING SEALING COMPOUNDS FOR USE AS BRIDGE DECK PROTECTIVE SYSTEMS

FINAL REPORT

CONDUCTED IN CONJUNCTION WITH
THE U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
EXPERIMENTAL FEATURE PROJECT NUMBER NY 73-01

Prepared by

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February 1984

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M.A.P. CODE 7.42-6-84-2

ABSTRACT

Penetrating concrete sealing compounds are designed to delay or prevent the corrosion of reinforcing steel due to the repeated application of deicing road salt. Four such compounds were applied in 1973 to twin three span monolithic bridge decks, in 12 feet wide bands parallel to the bridge skew. Untreated bands were left as control sections.

Concrete cores taken shortly after construction indicated there was no statistical difference between spans which might have biased future measurements. An initial field survey in October of 1974 indicated that almost no corrosion activity had occurred over the first winter in service.

A pachometer survey in October of 1977 showed that at least 50% of the measured locations (except on Span 1W) had less than the required 2" minimum design depth of cover. Annual fall surveys from 1976 through 1979 included half cell corrosion potential measurements, chloride ion concentration data, chain dragging for delaminations and visual observations. Statistical analysis of variance on the potential data showed that there was no significant difference between the treated and untreated sections from 1977 through 1979; the only difference detected was for the Linseed Oil treatment in 1976. Although this difference indicated that the Linseed Oil was performing slightly poorer than the remaining treatments, from an engineering standpoint there was no meaningful difference.

From 1973 through 1977, there was no statistical difference in chloride ion concentration data at the one, two and three inch nominal depths. The 1978 and 1979 chloride data was excluded from the analysis because of its highly sporadic nature. Significant surface distress (spalls, cracks and delaminations) had occurred by 1979, primarily at areas with extremely shallow depth of cover.

This report concludes that none of the penetrating sealing compounds provided additional protection from deck slab deterioration caused by deicing salt application when compared to the untreated control sections.

Finally, these decks have undergone continued deterioration since 1979, as evidenced by a 1982 Regional Bridge Deck Evaluation Report which recommended an overlay in 1983 under a rehabilitation contract.

CONTENTS

I. INTRODUCTION

A. Background

A major factor causing early bridge deck deterioration is the corrosion of reinforcing steel due to repeated application of deicing road salt. The chloride ion present in the salt reduces the normally high protective alkalinity of the concrete bridge deck. When sufficient chloride ion is present, the reinforcing steel oxidizes (rusts) and expands 2½ to 15 times in volume. This expansion causes tensile stresses to be exerted against the surrounding concrete. When these stresses exceed the tensile strength of the concrete, delamination and surface spalling result.

Possible solutions to this problem include: galvanized or epoxy coated rebars, waterproofing membranes, more impermeable overlays, cathodic protection, and the use of penetrating concrete sealing compounds.

B. Purpose and Scope

This study has been conducted in conjunction with the National Experimental and Evaluation Program (NEEP) No. 12, Bridge Deck Protective Systems. The purpose of this report is to evaluate the in-service performance of several different proprietary concrete sealing compounds.

II. PROJECT HISTORY

A. Project Site

The project is located on Bridge No. 3 of Contract FISH 71-6, Interstate Route 508, Oneonta: East Oneonta City Line to County Road 47, Otsego County (Figure 1). Bridge No. 3 is a twin, three-span composite beam structure carrying eastbound and westbound I-88 traffic over the Delaware and Hudson Railroad. Two of the three spans are 120'-2" long and the third is 93'-3". Each structure is built on a 60° skew (Figure 2).

B. Materials Under Test

The following penetrating concrete sealing compounds were studied:

1) Linseed Oil - N.Y.S.D.O.T. Special Specification Item 664 LD.

2) Aquadron - a polymer manufactured by Dural Internation Corporation.

3) Deepgard - a water soluble linseed oil base liquid, manufactured by Contech, Inc.

4) Sealcure - an epoxy-modified acrylic polymer manufactured by Cement Materials.

Appendix A contains the materials specification for Linseed Oil and manufacturer's data sheets for the three other sealers.

C. Construction Highlights

The Bridge No. 3 structures were both 8" monolithic concrete slab decks having a 2" design depth of cover over the top mat of reinforcing steel. The decks were poured and the concrete finishing operations completed in May, 1973. At that time, the Deepgard and Sealcure treatments (each a combination curing-sealing compound) were applied. The remaining areas were treated with white pigmented curing compound and allowed to cure for the minimum of 28 days. The Linseed Oil and Aquadron treatments were applied in early July of 1973, following a sandblasting operation to remove the curing compound.

The actual treatment-band locations are shown in Figure 3. An "Interim Phase 1 Bridge Deck Construction Report" detailing the deck construction and sealer application was issued in 1974.

D. Sealer Costs

The construction costs for each of the sealing compounds are shown in Table 1. Note that Linseed Oil and Aquadron required sand-blasting and a two-coat application, while Deepgard and Sealcure required only one-coat application. All costs are in 1973 dollars.

TABLE 1. SEALER CONSTRUCTION COSTS

Sealer	Material Cost Per gallon	Material Cost Total	Labor	Equipment	Total Cost Per Ft^2
Linseed Oil	$ 3.20	$210	$510	$70	$0.15
Aquadron	$17.50	$905	$510	$70	$0.27
Deepgard	$ 3.20	$ 95	$175	$15	$0.05
Sealcure	$ 5.00	$145	$175	$15	$0.06

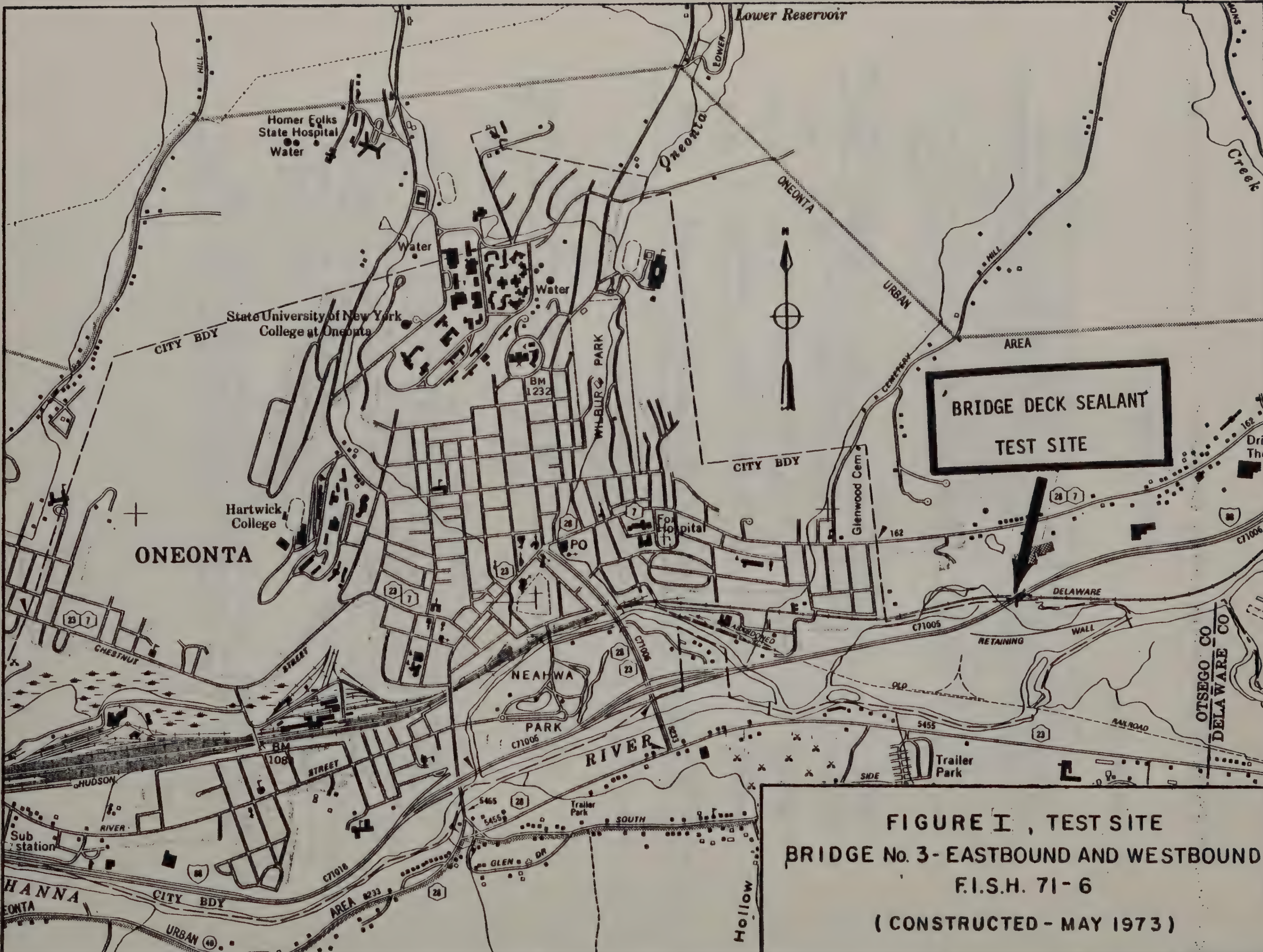


FIGURE I, TEST SITE
BRIDGE No. 3 - EASTBOUND AND WESTBOUND
F.I.S.H. 71-6
(CONSTRUCTED - MAY 1973)

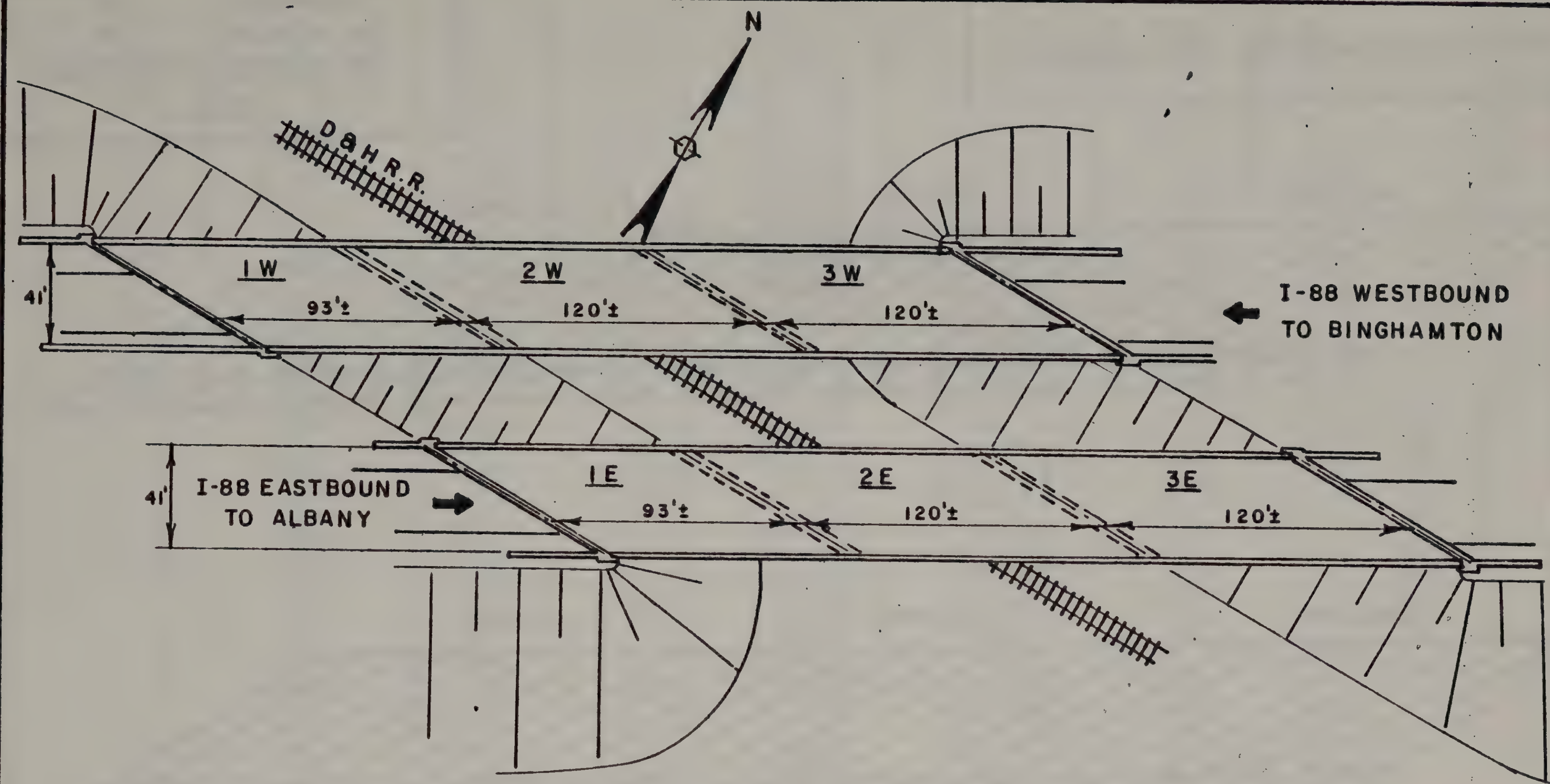
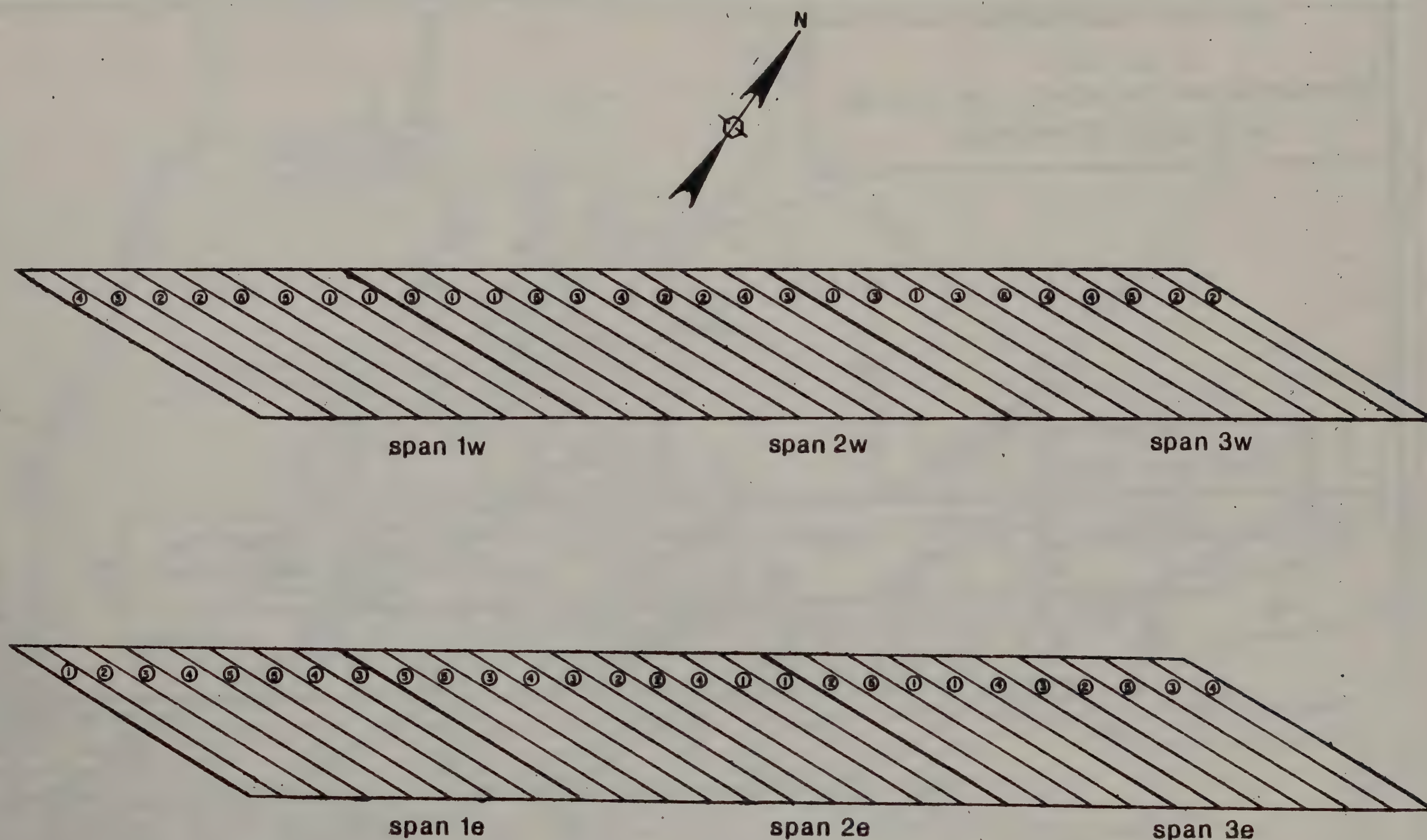


FIGURE II , TEST SITE
BRIDGE No. 3 - EASTBOUND AND WESTBOUND
F.I.S.H. 71-6
(CONSTRUCTED - MAY 1973)



KEY

TREATMENT	MATERIALS
1	LINSEED OIL
2	AQUADRON
3	DEEPGARD
4	SEALCURE
5	UNTREATED

FIGURE III, TREATMENT SCHEME

BRIDGE No. 3 - EASTBOUND AND WESTBOUND

F.I.S.H. 71 - 6

SCALE: 1" = 40'

III. METHODS OF EVALUATION

The following methods were used to evaluate the in-service performance of the sealing compounds:

Concrete Cores

Thirty concrete cores (5 per span) were taken in July, 1973. Subsequent laboratory analysis included density, per cent entrained air and chloride ion content.

Pachometer Survey

This survey was done using a James Pachometer in October, 1974 to determine the depth of concrete cover over the top mat of reinforcing steel. Data was collected using a 5'X10' grid parallel to the bridge skew. Because of improper calibration, the pachometer survey was re-done in October of 1977 on a 5'X5' grid pattern.

Corrosion Potential

These measurements were made on a 5'X5' grid pattern using a copper-copper sulphate reference electrode. Initial measurements were taken in October, 1974 at the core hole locations and at 10-15 additional random locations per span, and during each of the annual fall surveys (1976 through 1979).

Research with uncoated reinforcement has shown that for half-cell values (CSE) less than 0.20v, active corrosion is not occuring; and that for values above 0.35v, active corrosion is occuring. The range of values between 0.20v. and 0.35v. represents an area where corrosion activity is undefined.

Chloride Content

During each annual survey, powdered concrete samples were randomly taken at nominal 1", 2" and 3" depths (samples taken from 3/4 to 1 1/4"; 1 3/4 to 2 1/4" and 2 3/4 to 3 1/4"). The samples were later analyzed for total (soluble plus insoluble) chloride ion content.

Delaminations

A chain drag was used during each survey to identify delaminated areas, i.e. internal concrete planes that had fractured as a result of rebar corrosion.

Visual Observations

The locations of surface distress such as cracking or spalling were noted during each annual survey.

Miscellaneous Data

Other supportive data gathered includes traffic volume counts and salt application records.

IV. DATA SUMMARY

A. Concrete Cores (July, 1973)

Appendix B contains the laboratory test results obtained from the thirty concrete cores taken shortly after construction was completed. These results are within acceptable construction tolerances, indicative of quality concrete.

One-way analysis of variance models were set up to see if there were any statistically significant differences between spans which might bias future measurements. These results, also included in Appendix B, indicate that both density and percent air are not statistically different between spans at the 95% confidence level. Thus, we would expect the corrosion potential readings for a given sealer, transverse location, and depth of cover to be unaffected by the particular span under consideration.

B. Intial Field Survey (October, 1974)

The corrosion potential readings averaged 0.05v., indicating that almost no corrosion activity had occured over the first winter in service. These low potential readings would be expected on all areas including the untreated control sections until the chlorides had penetrated the deck to the level of the reinforcing steel. No surface distress on any of the six spans was noted, except for a small 10'X10' area in the center of Span 3W that had spalled. The depth of cover in this area was later found to range from 1/4" to 1/2" (average, 0.40"), indicating that subsidence cracking had occurred over the reinforcing bars.

C. Pachometer Survey (October 1977)

As mentioned earlier in this report, the initial pachometer survey of October, 1974 was redone in October, 1977. Appendix C contains contour plots of the October, 1977 pachometer data. A brief summary of the data is shown in Table 2 below.

TABLE 2. SUMMARY OF OCTOBER, 1977 PACHOMETER DATA

Span	# Data Points <0.99"	# Data Points 1.00"-1.99"	# Data Points >2.00"	% Of Data Points <0.99"	% Of Data Points 1.00"-1.99"	% Of Data Points >2.00"	Statistics Min.	Statistics Max.	Statistics Mean	Statistics Std. Dev.
1W	0	30	136	0	18	82	1.50	3.13	2.31	0.35
2W	26	116	79	12	52	36	0.00	2.88	1.67	0.61
3W	46	97	81	21	43	36	0.25	2.63	1.58	0.65
1E	0	81	84	0	49	51	1.00	2.75	1.91	0.39
2E	40	90	84	19	42	39	0.00	3.13	1.75	0.70
3E	7	120	90	3	55	42	0.88	3.00	1.88	0.60

D. Annual Fall Surveys (1976-1979)

1. Corrosion Potential Measurements

Appendix D contains histograms of the yearly corrosion potential measurements grouped by sealer treatment. Since the spans have already been demonstrated to be statistically equivalent, the yearly corrosion potential data for a given sealer was from all six spans combined.

The base of each histogram is the vertical axis which represents the midpoint of every 0.02 voltage interval from 0 to 0.70 volts. Each interval includes its upper limit, i.e. the 0.220 midpoint includes voltage values from 0.211 through 0.230, the 0.240 midpoint includes values from 0.231 through 0.250, etc. The frequencies are plotted horizontally to the right of the voltage interval with each asterisk representing a single reading. When there are too many readings to be plotted by asterisks, the actual number of readings are printed at the right end of the line of asterisks. The letter "M" within the line of asterisks represents the mean corrosion potential-voltage for the particular sealer group.

Included with each histogram is the corresponding one-way analysis of variance table which shows whether or not a statistically significant difference exists among the sealer treatments. Each table shows a calculated F-value, the ratio of the between group mean square to the within group mean square. The tail probability is the area under the F-distribution to the right of the calculated F-value for the given degrees of freedom. When this tail probability is less than 0.0100, then there exists a statistically significant difference between sealer treatments at the 99% confidence level.

A basic assumption underlying this analysis of variance is that the treatment variances (which when summed together yield the within-group variance estimate) are homogeneous, drawn from the same population of variances. To check this, Levene's test for equal variances is included with each analysis. When Levene's tail probability is less than 0.0100, then the variances are not homogeneous and two modified analysis of variance tests (Welch; Brown-Forsythe) were also performed. Neither of these modified tests assumes the homogeneity of variances.

A summary of the above statistics is given in Table 3 below.

TABLE 3. ANALYSIS OF VARIANCE SUMMARY (1976-1979)

SURVEY YEAR	TAIL PROBABILITIES				STATISTICALLY SIGNIFICANT DIFFERENCE @99% LEVEL
	ANOVA-1	LEVENE	WELCH	BROWN-FORSYTHE	
1976	0.0000	0.1845	N/A	N/A	Yes
1977	0.0634	0.1277	N/A	N/A	No
1978	0.0324	0.0028	0.0385	0.0317	No
1979	0.0207	0.0015	0.0337	0.0201	No

The above results indicate there is no statistically significant difference at the 99% confidence level between any of the sealer treatments as tested from 1977 through 1979. However, a difference between the treatments was detected for the 1976 survey year. To determine which of the sealer(s) were causing this difference, another set of analysis of variance tests were performed with each sealer being excluded once from the analysis. These results included in Appendix E are summarized in Table 4 below.

TABLE 4. ANALYSIS OF VARIANCE SUMMARY (1976)

EXCLUDED TREATMENT	CALCULATED F-VALUE	TAIL PROBABILITY	STATISTICALLY SIGNIFICANT DIFFERENCE @ 99% LEVEL
LINSEED OIL	3.39	0.0175	No
AQUADRON	14.97	0.0000	Yes
DEEPGARD	21.11	0.0000	Yes
SEALCURE	23.87	0.0000	Yes
UNTREATED	20.24	0.0000	Yes

These results show that only without linseed oil is there no statistically significant difference, or conversely, only with linseed oil is there a detectable statistical difference. Since the mean corrosion potential value for the linseed oil treatment (0.134 volts) exceeds the mean value for all the other treatments combined (0.109 volts) in 1976, we consider the linseed oil to be performing slightly poorer than the other treatments in 1976. However, since all the 1976 mean corrosion potential values are well within the non-active corrosion range, there is no meaningful difference in corrosion activity between any of the sealers tested during that year.

2. Chloride Ion Concentration Data

Appendix F contains a tabular summary of the chloride ion concentration data taken during the 1976 and 1977 fall surveys. Due to the sporadic nature of the 1978 and 1979 chloride data, it is being excluded from this report.

Also included in Appendix F are the one-way analysis of variance models to test whether a statistical difference exists among the sealer treatments for the 1973 cores and the 1976-1977 survey data (at the one, two and three inch depths).

The above statistics are summarized in Table 5 below.

TABLE 5. ANALYSIS OF VARIANCE SUMMARY

	TAIL PROBABILITIES				STATISTICALLY SIGNIFICANT DIFFERENCE
YEAR	ANOVA-1	LEVENE	WELCH	BROWN-FORSYTHE	@99% LEVEL
1973 Cores	0.9016	0.1750	N/A	N/A	No
1976 @ 1"	0.2056	0.0673	N/A	N/A	No
@ 2"	0.1258	0.5501	N/A	N/A	No
@ 3"	0.0687	0.3239	N/A	N/A	No
1977 @ 1"	0.0380	0.0078	0.0234	0.0392	No
@ 2"	0.5878	0.9709	N/A	N/A	No
@ 3"	0.7028	0.0507	N/A	N/A	NO

These analyses indicate there is no statistically significant difference between any of the sealers as measured by chloride ion concentration data taken from the July, 1973 cores and during the 1976-1977 fall surveys.

3. Contoured 1979 Corrosion Potential Data

Appendix G contains contoured plots of the most recent corrosion potential data. These plots are included to show relationships between high corrosion potential readings, shallow depth of cover and visually noted surface distress as discussed in Section V.

4. Chain Drag/Visual Surveys

Appendix H contains sketches showing the physical deterioration that had occurred as of our most recent annual survey in 1979. Several photographs of the badly deteriorated areas are included.

E. Miscellaneous Data

Appendix I contains the traffic volume data and the salt application records.

V. DISCUSSION

The contoured pachometer maps (Appendix C), contoured 1979 potential maps (Appendix G), and the 1979 visual survey maps (Appendix H) were all compared to see if any patterns or trends indicating superior treatment performance existed. Although no clear patterns were noted, the following relationships between the data were observed:

Spans 1E & 1W. Neither active corrosion nor shallow cover (1") had occurred on these spans. Surface distress was limited to minor spalling and delaminations along both armored joints on each span.

Span 2W. The only actively corroding area (100'-115' longitudinal, 15'-20' transverse) had little or no cover, with subsequent heavy spalling and delaminations. The Aquadron treatment had been applied to this area.

A second area (55'-70' longitudinal, 10'-20' transverse) showed corrosion activity in the undefined range with a typical 3/4" to 1" depth of cover; no resultant surface distress had yet occurred. This area contained Linseed Oil, Deepgard and no treatment.

Span 3W. The only two actively corroding areas (65'-90' longitudinal, 5'-10' transverse; 95'-120' longitudinal, 20'-30' transverse) had cover depths between 1/4" and 3/4" with subsequent heavy spalling and delaminations. This area contained Sealcure and no treatment. Also, minor spalling and delaminations had occurred along each armored joint.

Span 2E. Similar to Span 2W, the only actively corroding area on Span 2E (100'-115' longitudinal, 20'-25' transverse) had little or no cover, with subsequent heavy spalling and delaminations. The Deepgard and Aquadron treatments were applied to this area.

A 1/8" to 1/4" wide crack had opened up at mid-span, running almost parallel to the bridge skew and extending across the full-width of the deck. Also, spalling and delaminations had occurred along both joints.

Span 3E. Only several small scattered actively corroding areas had occurred at locations with cover depths between 3/4" and 1". Surface distress was limited to transverse cracking with spalling and delaminations along each armored joint.

VI. CURRENT STATUS

The inadequate depth of cover and resultant deck deterioration led the Department's Region 9 office to conduct their own inspections in January and April, 1982 and potential survey in July, 1982 to determine the need for bridge deck rehabilitation work. Appendix H includes a photograph from the January, 1982 inspection.

The rehabilitation work included deck scarification and removal of deteriorated concrete to the rebar level in the delaminated, spalled and high (> .035 volts) corrosion potential areas followed by placement of slab reconstruction concrete. A high density concrete overlay was then placed on the bridge decks and approach slabs. This Contract work was completed in November, 1983.

A summary of the approximate span areas which required concrete removal to the rebar depth is shown in Table 6 below.

TABLE 6. % OF SPAN AREAS REQUIRING CONCRETE REMOVAL TO REBAR DEPTH LEVEL

SPAN	% SPAN AREA
1E	8%
2E	12%
3E	30%
1W	3%
2W	10%
3W	30%

VII. OBSERVATIONS

The following are observations of this study:

1) The annual average corrosion potential values for each sealer treatment were always either in the non-active or the undefined "gray" areas of corrosion activity. The histograms in Appendix D suggest that these values are changing similarly for all treatments and have increased since the 1976 survey.

2) The 1976 corrosion potential data indicated that the linseed oil treatment had a statistically significant "inferiority" to the other treatments and to the untreated control sections; however, from an engineering standpoint there was no meaningful difference in corrosion activity.

3) The 1977 through 1979 corrosion potential data indicated no statistical difference in corrosion potentials for the treated or untreated sections.

4) From 1973 through 1977 (four years in service) there was no statistical difference in chloride ion concentration at the one, two, or three inch depth levels for the treated or untreated sections.

5) From 1974 through 1979, active corrosion occurred at less than 2% of each span's total potential measurement locations, except Span 3W which had 12% (1977) and 8% (1979) of its data points greater than 0.35 volts. These actively corroding areas exhibited significant surface distress with spalls, cracks and delaminations noted.

6) By July of 1982, active corrosion had increased to approximately 5% of the per span total potential measurement locations, except Spans 3E and 3W which had, respectively, 14% and 18% of their data points greater than 0.35 volts.

7) Between 50% to 65% of the measured pachometer readings on five of the six spans had less than the 2" minimum required design cover. Although this lack of cover has influenced the corrosion potential and chloride content data, there is no reason to believe than any one sealer in particular was unduly affected since all the sealer treatments were randomly applied to each span.

VIII. CONCLUSIONS

1) None of the penetrating sealer treatments tested provided additional protection from deck slab deterioration caused by de-icing salt application when compared to the untreated control sections.

2) There is a strong relationship between shallow depth of cover ($< 3/4"$) and deck slab distress (i.e. rebar corrosion, cracking, spalling).

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APPENDIX A

NYSDOT ITEM 664LD - LINSEED OIL & MANUFACTURER'S DATA SHEETS

ITEM 664LD - LINSEED OIL PROTECTIVE COATING FOR CONCRETE

1. Description. Under this item, the Contractor shall furnish and place a protective coating consisting of boiled linseed oil and mineral spirits on all exposed surfaces of the concrete as indicated on the plans or as directed by the Engineer.

2. Materials. The protective coatings shall consist of a blend of equal volumes of boiled linseed oil and mineral spirits meeting the following requirements, and shall be furnished blended in containers.

a. Boiled Linseed Oil. The boiled linseed oil shall be pure linseed oil that has been treated by heating (i.e., kettle boiled) with suitable compounds of drying metals so as to produce a product that will dry (set to touch) in less than sixteen hours at 25$\pm$1 C.

Boiled linseed oil shall meet the requirements of the ASTM Specifications D 260, Type I, modified as follows:

	Min.	Max.	ASTM Test
Viscosity (Gardner Holdt)	A		D 1545
Color (Gardner)		13	D 1544
Acid Value	4	6	D 555

b. Mineral Spirits (Paint Thinner). This specification covers a grade of petroleum distillate known as mineral spirits or petroleum spirits for use in thinning paints.

The mineral spirits shall be clear and free from water and suspended matter, and the color shall be no darker than an aqueous solution of potassium dichromate containing 0.0048 grams/liter - Test Method ASTM D 156.

Mineral Spirits shall meet the requirements of the ASTM Specification D 235, modified as follows:

	Min.	Max.	ASTM Test
Aniline Point	43 C (110 F)	59C (138F)	D 611
End Point		210C (410F)	D 86

ITEM 664ID-LINSEED OIL PROTECTIVE COATING FOR CONCRETE-cont'd.

c. Inspection and Testing. The Contractor shall furnish the Deputy Chief Engineer (Design) with three (3) certified copies of the chemical analysis of the two components. Samples may be taken in the field by the Engineer to be forwarded to the Laboratory for check analysis. Such samples shall be taken prior to actual use of the material. Application of the sampled material shall be delayed until the results of Laboratory testing indicates acceptability.

d. The Linseed Oil Protective Coating shall meet the following requirements:

	Limits Min.	Max.	ASTM TEST
Acid Value		5	D 1639
Iodine Value	92		D 1959
Saponification Value	100		D 1962
Drying time on glass		16	D 1953
Nonvolatile Content	54%	60%	D 1960 *
Specific Gravity 25/25C	.850	.859	D 1963
Flash Point (Tag Closed Cup)	100F		D 56
Distillation Test Percentage			
Recovered at 177C	25		D 86
Recovered at 200C	45		D 86
Color (Gardner)		13	D 1544

*D 1960 "Loss on Heating" method shall be modified as follows: A sample of 1.2±.2 gm. shall be weighed into an aluminum foil moisture dish and the sample allowed to remain in the oven for one hour at 105C with a stream of nitrogen playing over the sample.

3. Construction Details.

a. Linseed Oil Protective Coating shall be applied to dry concrete surfaces previously cleaned of all dirt, debris, oil, grease or any other foreign substance which would inhibit penetration, adhesion or drying of the protective coating. New concrete surfaces shall not be treated in less than twenty-eight (28) days after placing.

ITEM 664LD - LINSEED OIL PROTECTIVE COATING FOR CONCRETE-cont'd.

A dry surface is defined as one which, when a piece of clean dry blotting paper is laid on the surface in intimate contact for one (1) hour, the paper does not show the presence of any moisture.

b. The protective coating shall be applied, as directed, by approved mechanical pressure spray equipment, by portable hand spray equipment, by brushing or rolling, or a combination of these methods, to insure complete, even coverage of the concrete surface being treated, at the specified rate. All equipment used for applying Linseed Oil Protective Coating for Concrete shall be clean and free from all material which will contaminate the coating. Spray equipment, when used, shall be so adjusted that the nozzle is not more than 18 inches from the surface being treated.

c. The requirements of Item 76 - Maintenance and Protection of Traffic - shall apply. Spray equipment, when used, shall be equipment with suitable deflecting devices to prevent the Linseed Oil Protective Coating for Concrete from being blown on the adjacent traffic, shrubs and any other surfaces not requiring treatment.

d. The protective coating shall be applied in two (2) coats at the rate of 0.025 ± 0.002 gallon per square yard for the first coat and at the rate of 0.015 ± 0.001 gallon per square yard for the second coat.

e. The protective coating, preferably, shall be applied under weather conditions suitable for drying when the temperature of the air and the concrete surface is between 60 F and 80 F. In no case shall the application of the first or second coat be permitted when air and/or concrete temperature is below 35 F and the air temperature is not rising, or higher than 100 F, or the relative humidity more than 85%, or weather predictions indicate rain in twenty-four (24) hours, or in the opinion of the Engineer, conditions are such as to produce unsatisfactory results.

f. The first application of the protective coating shall be permitted to dry until penetration is complete and all tackiness of the coating has disappeared but not less than for a period of twenty-four (24) hours. No traffic shall be permitted on the first application.

ITEM 664L[D] - LINSEED OIL PROTECTIVE COATING FOR CONCRETE-cont'd.

g. The second application shall be made immediately after the first application has dried, as specified in "f". All surfaces shall be closed to all traffic until all tackiness of the coating has disappeared and no pick up will result from the traffic but not less than for a period of twenty-four (24) hours.

h. Safety Precautions. At no additional expense to the State, every precaution must be taken to protect traffic, workmen, and the concrete surface against the occurrence of fire in the presence of inflammable and volatile mineral spirits blended into the protective coating. Slippery pavement, or any other hazard or inconvenience to traffic, resulting from the application of the protective coating, shall be corrected by the Contractor as directed by the Engineer prior to permitting the use of the treated surface by traffic.

4. Method of Measurement. The quantity to be paid for under this item will be the number of gallons of the protective coating of blended linseed oil and mineral spirits incorporated in the work in accordance with this specification.

5. Basis of Payment. The unit price bid per gallon shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

DATA SHEET

DURAL INTERNATIONAL CORP.

95 BROOK AVENUE

DEER PARK, N. Y. 11729

516-586-1655

AQUADRON

Penetrating Sealer for Concrete and Masonry

DESCRIPTION:

Aquadron is a new polymer, particularly suited for protection of concrete surfaces. Aquadron offers unexcelled protection against the deleterious effects of deicing salts and chemicals and rust intrusion; a problem quite prevalent on pier caps, columns of bridges and other surfaces.

ADVANTAGES:

Water Clear
Extremely low viscosity
High penetration potential & affinity for concrete
Will not reduce skid resistance
Permits Vapor Transmission yet waterproofs
Rapid drying-usually 3-4 hours
Water Clean Up

PROPERTIES:

Mixing Ratio - BASE to HARDENER - 4:1
Viscosity - 10-20 cps
Shelf Life - Over 1 year
Working Life - 4 hours
Drying Time - 1 hour
Cure Time - 48 hours

APPLICATION: Apply by roller, brush or spray. If spray equipment is used, airless is preferred, although air type equipment may be used.

Apply at the rate of 200-250 sq.ft./gal. Two coats are preferred. The second coat may be applied after the first coat has dried 1 hour. Do not apply below 35°F. Allow to dry before opening to traffic for at least 1 hour.

Clean Equipment with water before it drys.

MIXING INSTRUCTIONS: Transfer contents of HARDENER into BASE and mix thoroughly.

SAFETY & CLEANLINESS:

Aquadron is a chemical and should be handled accordingly. Apply under conditions of good ventilation. Avoid contact with skin as sensitization may occur, or cause allergenic reactions. Wash hands with soap and water. If eye contact occurs, flush thoroughly with copious amounts of water.

SURFACE PREPARATION: Surfaces must be clean and dry, free of dirt dust, grease or oil.

PDS-AQD-1272

SPEC-DATA

This Spec-Data Sheet conforms to editorial style prescribed by The Construction Specifications Institute. The manufacturer is responsible for technical accuracy.

1. PRODUCT NAME

PITTSBURGH® PAINTS

Deepgard® Concrete Preservative — Clear & Pigmented

2. MANUFACTURER

PPG INDUSTRIES, INC.
Coatings & Resins Division
One Gateway Center
Pittsburgh, Pennsylvania 15222
Phone (412) 434-2192

3. PRODUCT DESCRIPTION

NOT A PAINT *Deepgard* is a fast-dry (2½-3½ hours) anti-spalling agent and sealer for concrete both old and new. A vegetable oil penetrant for concrete surfaces, it retards scaling, reduces surface erosion and acts as an ice and snow release agent.

Basic Uses: Beneficial for all exposed porous concrete surfaces where salts, chemicals and weathering may cause surface deterioration. For parking ramps and garages, gas stations, terminals, ice rinks, curbs, roads, bridges, decks, walks, driveways, loading docks, plant floors, precast stairs, bumper blocks, breakwalls, docks, airport runways, grooved traffic surfaces, traffic islands and median strips. Seals micro-cracks.

Limitations:

Not recommended for use on non-porous surfaces.

Pigmented sealer not for heavily traveled (vehicle) surfaces.

Composition and Materials:

Composition: Clear Type

Non Volatile Vegetable Oil	40%
Volatile mineral spirits	57%
Other*	3%
	100%

Composition: Pigmented Types

Non Volatile Vegetable Oil	40%
Volatile mineral spirits	54%
Pigments	3%
Other*	3%
	100%

*Contains metallic driers, fungicide agent, stabilizing agents, wetting and anti-skinning agents.

Sizes: One gallon and 5 gallon cans; 52 gallon drums, bulk. Pigmented material available in agitator type drums.

Colors: Terra Cotta, Suburban Green, Sand Tan, Charcoal Black, Vivid Red, Cement Gray, Traffic Yellow, Slate, and Clear.

Note: Clear *Deepgard* is not protected with mildewcide.

Applicable standards: Conforms to Los Angeles Rule 66 pertaining to low aromatic content of the solvent.

4. TECHNICAL DATA

Type: Principally linseed oil - 40% by volume.

Viscosity: 25-35 seconds as measured with No. 1 Zahn Cup

Flash Point: Over 80°F

Spreading Rate: Two applications are generally recommended, applied 400 to 500 square feet per gallon each application, depending on porosity of surface. Steel-troweled patios may require only one application to seal the surface. When surfaces are beginning to deteriorate, the concrete is usually more porous; and hence, more *Deepgard Concrete Preservative* is required to seal it. A film should **not** form on the surface.

Dry Time:

First Application-walk on surface in 3½ hours if fully penetrated.

Second application—allow 6 hours before use. Weather and temperature conditions govern. Drying time will be shortened at temperatures above 60°F.

5. INSTALLATION

Surface Preparation: Must be dry. Remove all dirt, loose scale, leaves, grass, dust. Wipe up wet oil or grease.

Surface should be sound. Seal cracks with oil type filler if desired. Remove efflorescence where possible by washing down. Acid etching is not necessary.

Method of Application: Use long-handled paint roller with medium to long nap for small areas and back-pack type sprayer for larger areas. Various types of spray equipment are suitable for large areas.

AVOID OVER-APPLICATION.

Thinning: Product is ready to use.

Equipment Clean-up: Use *Leptyne®* paint thinner or mineral spirits promptly after use. Trisodium phosphate in hot water, or strippers, may be required if equipment is not cleaned promptly.

Precautions: Air temperature should be 60° or higher.

Not recommended on recently sealed surfaces such as wax type cure compounds or chlorinated rubber seals. Use simple penetration test by applying sparingly to surface and observing. If penetrated after 10 minutes, surface would benefit from *Deepgard Concrete Preservative* treatment; or, find smoothest part of area to be treated, and using a 2 or 3 inch nylon brush, apply water on a one square foot area. Put on enough water so a "shine" is noticeable. Shine should disappear in 4 minutes if surface is suitable. If not, do not apply *Deepgard.* On newly placed concrete, allow 15 days or longer before treating. Apply on sound, dry, unsealed surfaces.

CAUTION! Combustible.

- Use with adequate ventilation.
- Avoid prolonged contact with skin.
- Avoid prolonged breathing of vapor or spray mist.
- Keep container closed when not in use.
- **Keep out of the reach of children.**

6. AVAILABILITY AND COSTS

Availability: Immediately available in one and 5-gallon containers from Pittsburgh Paint Centers and building contractor supply houses. Drums and bulk quantities quickly obtainable on order.

Costs: Prices quoted on request.

7. GUARANTEE

PPG Industries, Inc. represents that each product described herein will meet its high standards of performance and quality when applied according to directions. Provided the storage, handling and application procedures recommended by PPG are followed, any product which does not perform as described herein will be replaced or the purchase price refunded.

8. MAINTENANCE

Treatment is recommended in form of a single application every third year on surfaces subject to de-icing chemicals and wear. Extreme traffic and wear may require more frequent treatment. (Determine if treatment necessary by observing degree of water penetration on small test area.)

9. TECHNICAL SERVICES

Available through the nearest *Pittsburgh Paints* representative, or *Pittsburgh Paints Center.* See the yellow pages of your telephone book.

10. FILING SYSTEMS

Deepgard General Catalogs
Application and Usage Sheets

SC SEAL CURE

1. PRODUCT NAME
SC SEAL CURE—A sealing, curing, hardening and dust-proofing agent.

2. MANUFACTURER
Cement Materials
1222 Ardmore Avenue, Itasca, Illinois 60143
Phone 312 773-9441

3. PRODUCT DESCRIPTION
SC Seal Cure is a superior sealing and curing compound for concrete and terrazzo. It is a blend of polymer resins in a fast evaporating solvent.

BASIC USES: It is formulated to seal, cure and dustproof fresh concrete and terrazzo surfaces in one application. It also seals and dustproofs the surface of old concrete, thus extending its life. SC Seal Cure provides protection against sudden rain showers within thirty minutes after application. It is quick drying, thus preventing possible damage to freshly poured concrete. It provides a seal that is impervious to acid, alkali, grease, oil, water and de-icing salts.

SC Seal Cure minimizes hair cracking and spalling of horizontal and vertical concrete surfaces in both interior and exterior exposures. SC Seal Cure has proven itself in both interior and exterior surfaces that have been covered or left exposed in residential, institutional, commercial or industrial projects. Typical applications include garages, offices, warehouses, plants, bridge decks, highways, parking decks, airport runways and parking strips and hangers.

SC Seal Cure may be used on both interior and exterior surfaces. It can be recoated at any time. It does not contain any chlorinated resins; it resists discoloration (yellowing) due to ultra-violet degradation (exposure to sunlight).

COMPOSITION AND MATERIALS: This is a **new** formula polymer. It is a single component, ready-to-use material that may be sprayed, brushed or rolled on the concrete surface.

SIZES: Packaged in 1 and 5 gallon pails and 55 gallon drums.

COLORS: SC Seal Cure is available in clear form, with fugitive dye, or white pigmented. Several standard colors are available upon request.

APPLICATION STANDARDS: SC Seal Cure meets the requirements of the following specifications: ASTM C-309, ASTM C-156-66T (Method of testing), AASHO M-148 (Type 1 Clear), U.S. Navy 45ya 7-03 (c), Navdock 13 YF, Asphalt and Vinyl Asbestos Tile Institute. SC Seal Cure is available to comply with Fed. Specs. TT-C-00800 and CRD-C-300.

SPECIFICATIONS: SC Seal Cure, a product of Cement Materials, shall be used to seal, cure, and dust-proof newly poured concrete surfaces where indicated, and applied in strict accordance with the manufacturer's written instructions.

4. TECHNICAL DATA
The solution is of low viscosity and will penetrate the surface up to 1/8 inch, subsequently providing protection for years after initial application.

It is compatible with and provides good adhesion for paints and tile adhesives (asphaltic cutback adhesive recommended) without further modification; it is compatible with joint sealants; it makes sandblasting unnecessary.

Extensive testing by independent laboratories established that SC Seal Cure membranes conform to the acceptable standards of the above specifications and the claims made under Item 3, Product Description. Detailed reports are available upon request.

5. INSTALLATION
PREPARATORY WORK: (New Concrete) SC Seal Cure should be applied to green concrete as soon as the water sheen has disappeared from the surface and the concrete can be walked on or, for vertical surfaces, as soon as the forms have been stripped and the surface has been rubbed.

High Flash Point (minimum 110° F.) lessens the hazards during application at ambient temperatures. SC Seal Cure is **not** a Red Label product.

(Old Concrete) SC Seal Cure should be applied only after all stains and foreign materials have been removed and the surface has been washed with a 7:1 solution of muriatic acid. It should then be washed with water and thoroughly dried before applying SC Seal Cure.

METHODS OF APPLICATION: SC Seal Cure may be applied to the surface by spray, brush, short-nap mohair roller or sheepskin applicator.

COVERAGE: One gallon will cover 200-600 sq. ft., depending upon surface texture and specification requirements.

6. AVAILABILITY AND COST
Factory sealed containers are available through distributors located throughout the United States.

Material costs are available from local distributors.

7. GUARANTEES
When applied in accordance with manufacturer's directions it is guaranteed to meet all claims made for it in the proper curing of concrete and terrazzo floors.

Sales specifications, although current at time of publication, are subject to change due to process improvements. For latest product specifications, contact our nearest sales office.

8. MAINTENANCE
SC Seal Cure permits easy maintenance of surfaces while providing a surface coating that cannot be stripped away with standard industrial and commercial cleaning compounds. The frequency of subsequent applications is to be determined by the user.

9. TECHNICAL SERVICES
Complete technical information and literature is available from authorized distributors. Application engineering and testing facilities are available upon request.

10. FILING SYSTEMS
Architectural Literature
SC Seal Cure
Cement Materials
Additional literature is available upon request.

Distributed by:

Cement Materials
1222 Ardmore Avenue
Itasca, Illinois 60143
Phone 312 773-9441

EXCLUSIVE MANUFACTURERS OF
SPEED-CRETE
quick setting–high strength concrete.

APPENDIX B

CONCRETE CORE LABORATORY ANALYSIS
AND
ANALYSIS OF VARIANCE MODELS

LABORATORY ANALYSIS OF JULY, 1973 CONCRETE CORES

CORE #	SPAN	TREATMENT	CORE DENSITY (lb./ft.^{3})	CHLORIDE CONTENT (lb./yd.^{3})	ENTRAINED AIR %
1	1E	Linseed Oil	139	0.6	5.1
2	1E	Aquadron	139	0.6	3.0
3	1E	Deepgard	141	0.7	5.4
4	1E	Sealcure	136	0.8	6.5
5	1E	Untreated	133	0.4	6.2
6	2E	Linseed Oil	139	0.4	3.4
7	2E	Aquadron	144	0.9	4.1
8	2E	Deepgard	143	1.0	3.6
9	2E	Sealcure	←	NO DATA	→
10	2E	Untreated	140	0.6	5.3
11	3E	Linseed Oil	129	0.5	13.0
12	3E	Aquadron	143	0.6	6.6
13	3E	Deepgard	137	0.4	3.3
14	3E	Sealcure	132	0.2	7.9
15	3E	Untreated	132	0.6	8.6
16	1W	Linseed Oil	139	0.5	6.5
17	1W	Aquadron	141	0.4	5.8
18	1W	Deepgard	138	0.6	7.4
19	1W	Sealcure	141	0.5	4.1
20	1W	Untreated	133	0.5	8.2
21	2W	Linseed Oil	135	0.4	7.9
22	2W	Aquadron	138	0.4	6.7
23	2W	Deepgard	144	0.5	6.0
24	2W	Sealcure	136	0.5	9.7
25	2W	Untreated	141	0.6	4.7
26	3W	Linseed Oil	133	0.8	4.6
27	3W	Aquadron	140	0.7	3.5
28	3W	Deepgard	132	0.6	4.9
29	3W	Sealcure	137	1.0	8.9
30	3W	Untreated	139	0.6	6.2
		Average	138 PCF	0.60 PCY	6.1%
		Range	129-144 PCF	0.20-1.00 PCY	3.0-13.0%

ONE-WAY ANALYSIS OF VARIANCE

OF % ENTRAINED AIR BY SEALER TREATMENT

JULY, 1973 CORES

TOTAL NUMBER OF OBSERVATIONS = 29

TREATMENT GROUP	N	MEAN	SDEV	VAR
LINSEED OIL	6	6.75	3.44	11.80
AQUADRON	6	4.95	1.62	2.63
DEEPGARD	6	5.10	1.62	2.34
SEALCURE	5	7.42	2.21	4.87
UNTREATED	6	6.53	1.56	2.43

ANALYSIS OF VARIANCE TABLE

	SUMSQ	D O F	MEAN SQ	F
BETWEEN GROUPS	26.3	4	6.6	1.37
WITHIN GROUPS	115.5	24	4.8	
TOTALS	141.8	28		

$F_{(4,24,0.05)} = 2.78$

ONE-WAY ANALYSIS OF VARIANCE

OF % ENTRAINED AIR BY SPAN

JULY, 1973 CORES

TOTAL NUMBER OF OBSERVATIONS = 29

SPAN	N	MEAN	SDEV	VAR
1W	5	6.40	1.57	2.48
2W	5	7.00	1.90	3.62
3W	5	5.62	2.07	4.29
1E	5	5.24	1.38	1.89
2E	4	4.10	0.85	0.73
3E	5	7.88	3.51	12.34

ANALYSIS OF VARIANCE TABLE

	SUMSQ	D O F	MEAN SQ	F
BETWEEN GROUPS	41.2	5	8.2	1.88
WITHIN GROUPS	100.6	23	4.4	
TOTALS	141.8	28		

$F_{(5,23,0.05)} = 2.64$

ONE-WAY ANALYSIS OF VARIANCE

OF CORE DENSITY BY SEALER TREATMENT

JULY, 1973 CORES

TOTAL NUMBER OF OBSERVATIONS = 29

TREATMENT GROUP	N	MEAN	SDEV	VAR
LINSEED OIL	6	135.7	4.13	17.07
AQUADRON	6	140.8	2.32	5.37
DEEPGARD	6	139.2	4.45	19.77
SEALCURE	5	136.4	3.21	10.30
UNTREATED	6	136.3	4.08	16.67

ANALYSIS OF VARIANCE TABLE

	SUMSQ	D O F	MEAN SQ	F
BETWEEN GROUPS	116.3	4	29.1	2.08
WITHIN GROUPS	335.5	24	14.0	
TOTALS	451.8	28		

$F_{(4,24,0.05)} = 2.78$

ONE-WAY ANALYSIS OF VARIANCE

OF CORE DENSITY BY SPAN

JULY, 1973 CORES

TOTAL NUMBER OF OBSERVATIONS = 29

SPAN	N	MEAN	SDEV	VAR
1W	5	138.4	3.29	10.80
2W	5	138.8	3.70	13.70
3W	5	136.2	3.56	12.70
1E	5	137.6	3.13	9.80
2E	4	141.5	2.38	5.67
3E	5	134.6	5.50	30.30

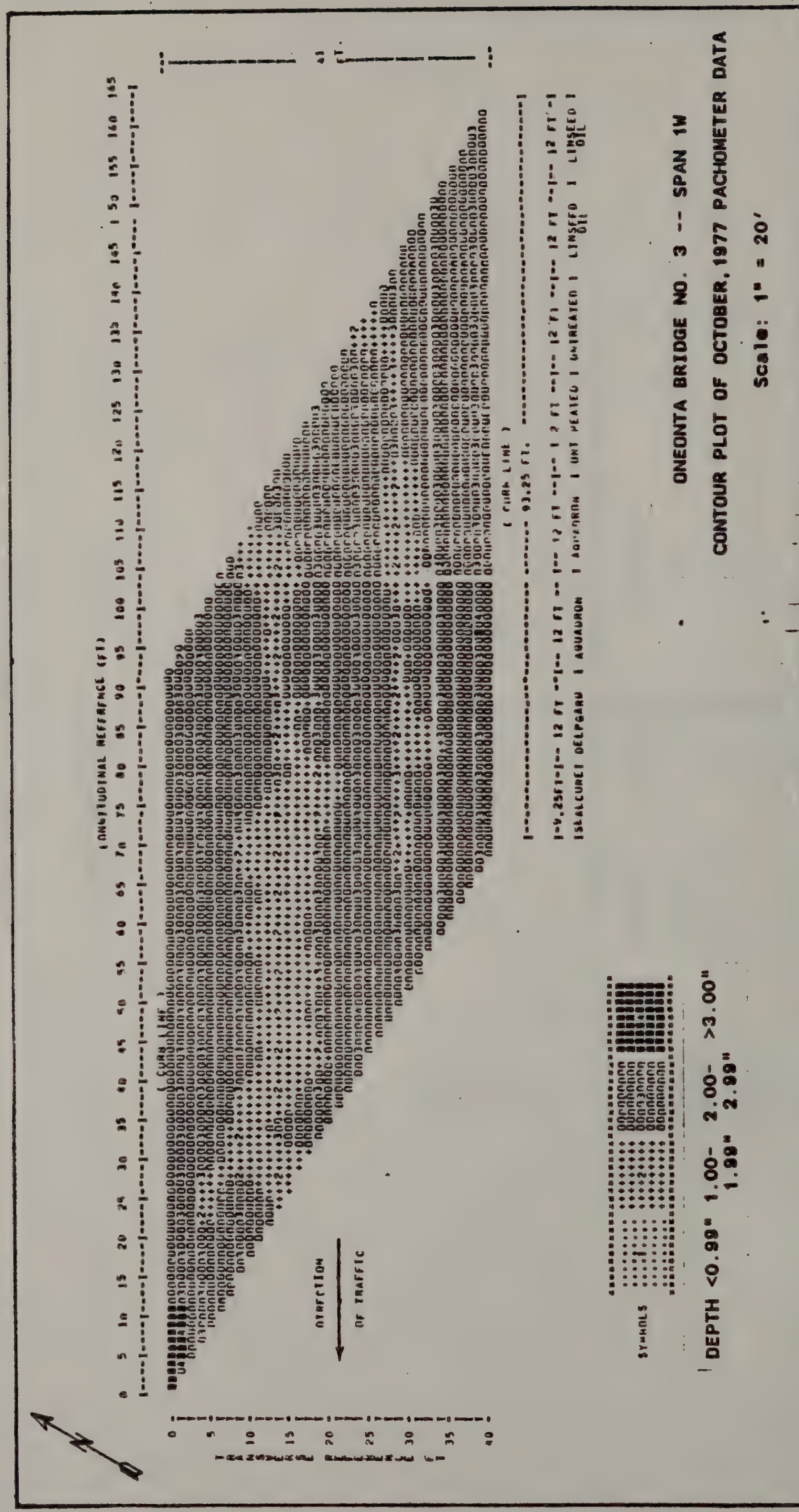
ANALYSIS OF VARIANCE TABLE

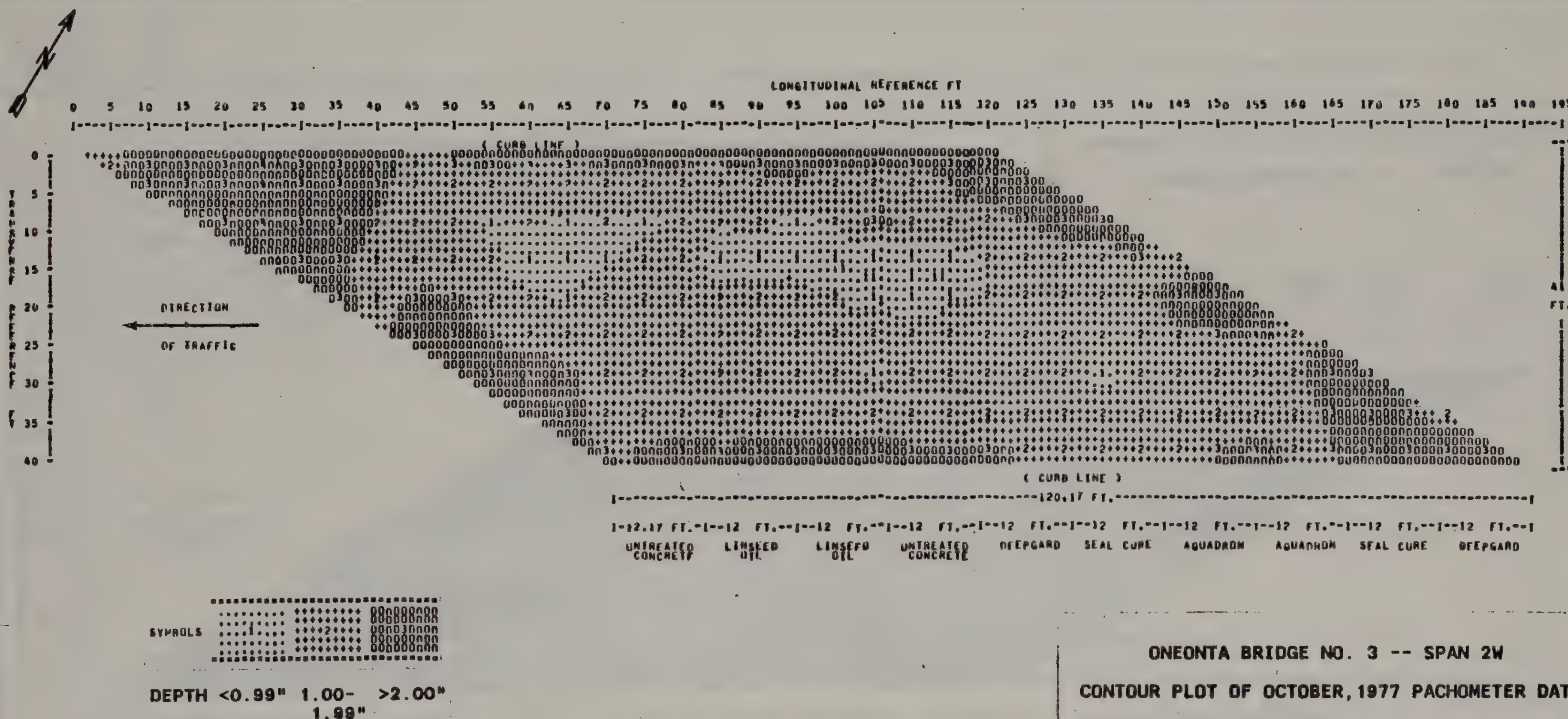
	SUMSQ	D O F	MEAN SQ	F
BETWEEN GROUPS	125.6	5	25.1	1.77
WITHIN GROUPS	326.2	23	14.2	
TOTALS	451.8	28		

$F_{(5,23,0.05)} = 2.64$

APPENDIX C

CONTOUR PLOTS OF OCTOBER, 1977 PACHOMETER DATA

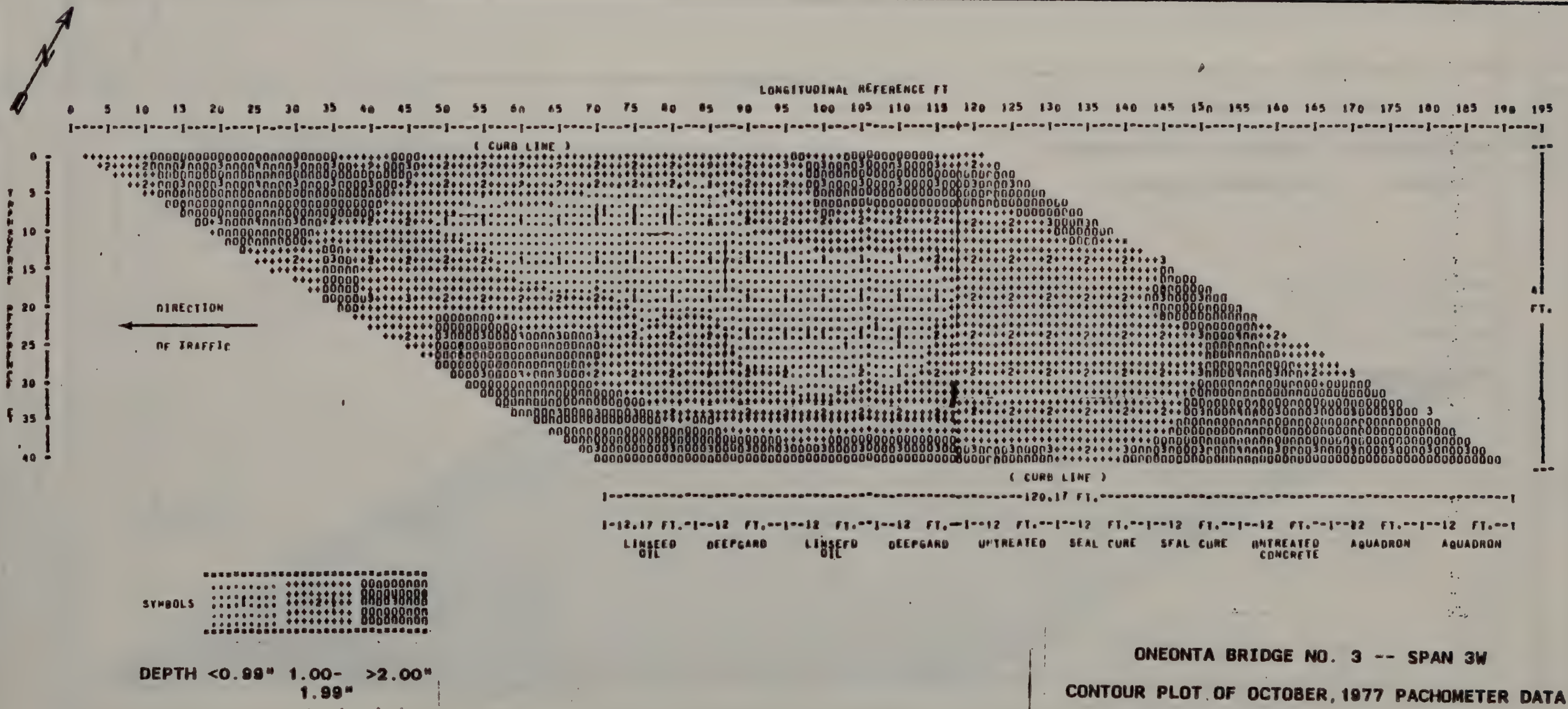

LONGITUDINAL REFERENCE (FT)
TRANSVERSE REFERENCE FT
CURB LINE
DIRECTION OF TRAFFIC
SYMBOLS
DEPTH <0.99" 1.00-1.99" 2.00-2.99" >3.00"
ONEONTA BRIDGE NO. 3 -- SPAN 1W
CONTOUR PLOT OF OCTOBER, 1977 PACHOMETER DATA
Scale: 1" = 20'



ONEONTA BRIDGE NO. 3 -- SPAN 2W

CONTOUR PLOT OF OCTOBER, 1977 PACHOMETER DATA

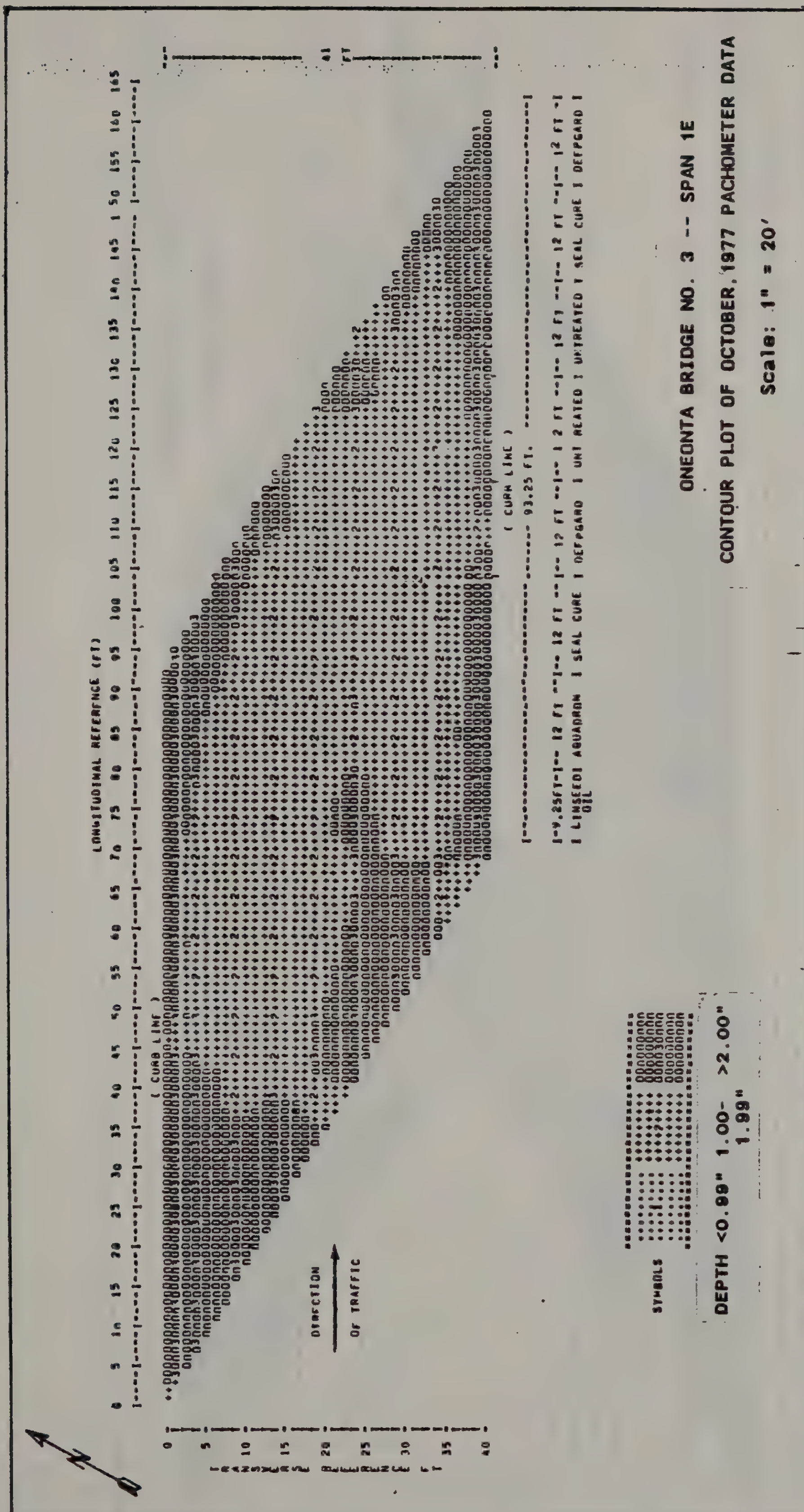
Scale: 1" = 20'



ONEONTA BRIDGE NO. 3 -- SPAN 3W

CONTOUR PLOT OF OCTOBER, 1977 PACHOMETER DATA

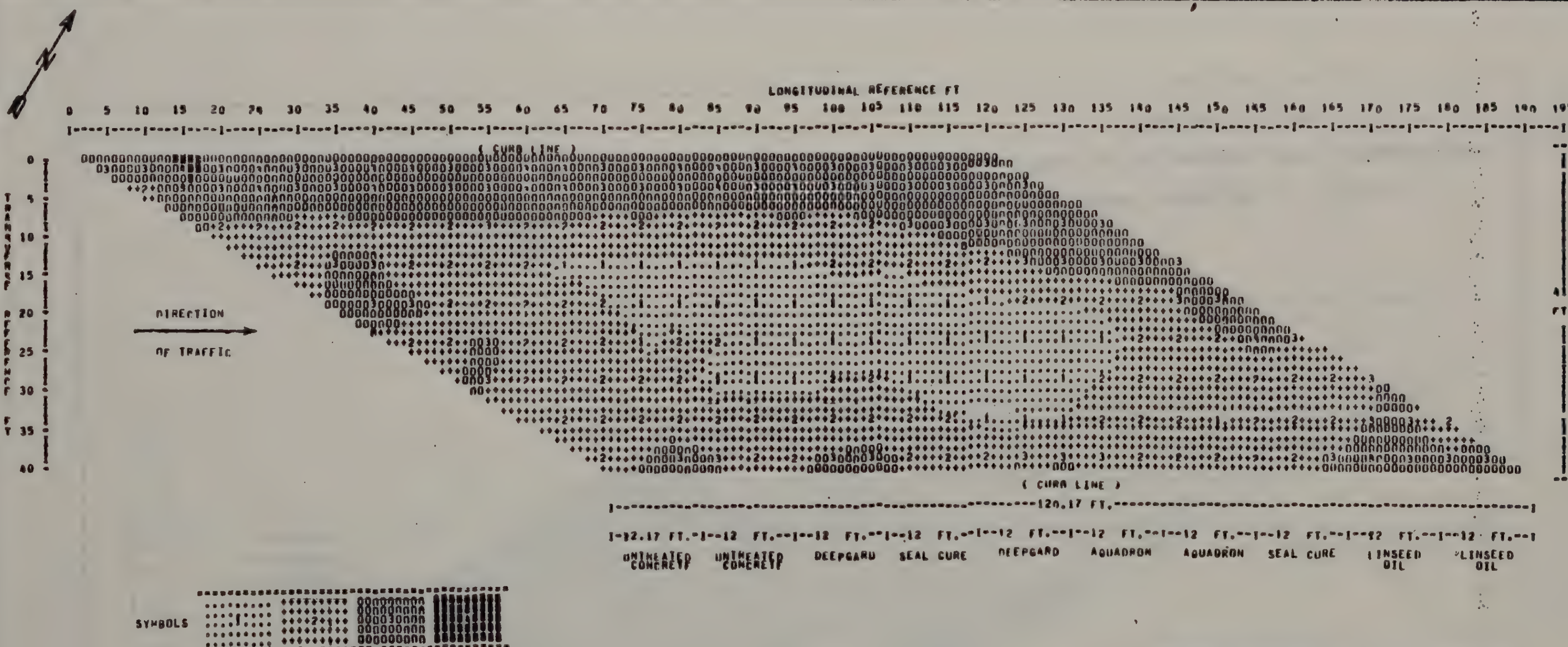
Scale: 1" = 20'



ONEONTA BRIDGE NO. 3 -- SPAN 1E

CONTOUR PLOT OF OCTOBER, 1977 PACHOMETER DATA

Scale: 1" = 20'

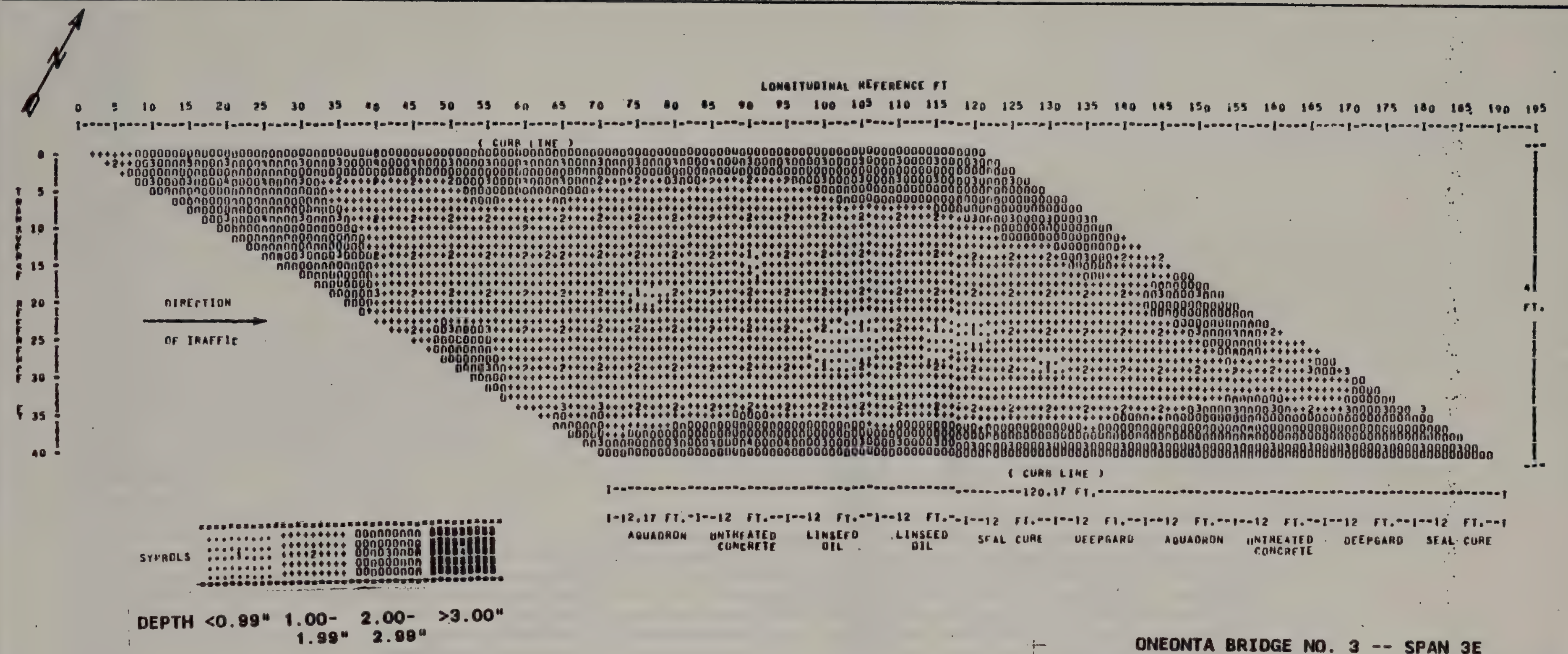


DEPTH <0.99" 1.00- 1.99" 2.00- 2.99" >3.00"

ONEONTA BRIDGE NO. 3 -- SPAN 2E

CONTOUR PLOT OF OCTOBER, 1977 PACHOMETER DATA

Scale: 1" = 20′



ONEONTA BRIDGE NO. 3 -- SPAN 3E

CONTOUR PLOT OF OCTOBER, 1977 PACHOMETER DATA

Scale: 1" = 20′

APPENDIX D

CORROSION POTENTIAL HISTOGRAMS AND ANALYSIS OF VARIANCE (1976-1979)

```
1976 ONEONTA POTENTIALS BY TREATMENT

         LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREATED
          ....................+...................+...................+...................+...................+
MIDPOINTS
   0.700)
   0.680)
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)
   0.560)
   0.540)
   0.520)
   0.500)
   0.480)
   0.460)
   0.440)                                                             *
   0.420)                                                                                 *
   0.400)
   0.380)
   0.360)
   0.340)
   0.320)
   0.300)*
   0.280)
   0.260)*                   *                                                            *
   0.240)*                   *                                        ***
   0.220)******              *                   ***                  ****                ***
   0.200)******              *                   **                   ****                *
   0.180)***********         ****                ******               *****               ****
   0.160)*****************31 **************      *****************20 *************       *************
   0.140)M****************63 *****************32 *****************43 *****************38 *****************34
   0.120)*****************47 *****************30 M****************37 M****************44 *****************47
   0.100)*****************27 M****************46 *****************39 *****************34 M****************52
   0.080)*************       *****************40 *****************33 *****************31 *****************39
   0.060)**************      *****************34 *****************27 *****************23 *****************34
   0.040)***                 ******************  ***************     ******************* *****************
   0.020)*                   **********          *                   *****               ****
   0.000)***                 **

MEAN          0.134               0.102               0.113               0.114               0.108
STD.DEV.      0.043               0.043               0.039               0.050               0.044
R.E.S.D.      0.040               0.043               0.041               0.047               0.041
S. E. M.      0.003               0.003               0.003               0.003               0.003
MAXIMUM       0.300               0.270               0.230               0.450               0.430
MINIMUM       0.000               0.000               0.020               0.020               0.020
SAMPLE SIZE     228                 234                 226                 224                 250
                                 ******************************* ANALYSIS OF VARIANCE TABLE *******************************
                                 *
  ALL GROUPS COMBINED            *    SOURCE               SUM OF SQUARES       DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                 *
MEAN                 0.114       *    BETWEEN GROUPS           0.1290          4       0.0323       16.61          0.0000
STD.DEV.             0.045       *    WITHIN  GROUPS           2.2471       1157       0.0019
R.E.S.D.             0.044       *
S. E. M.             0.001       *    TOTAL                    2.3761       1161
MAXIMUM              0.450       ******************************************************************************************
MINIMUM              0.000       *    LEVENE'S TEST FOR EQUAL VARIANCES   4,1157                     1.55           0.1845
SAMPLE SIZE           1162       ******************************************************************************************
```

```
1977 ONEONTA POTENTIALS BY TREATMENT

         LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREATE
        ....................+...................+...................+...................+...................+
MIDPOINTS
   0.700)
   0.680)
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)                                                           *
   0.560)                                                                               *
   0.540)
   0.520)                   *                                       *
   0.500)                                                                               *
   0.480)*                  *                                       *
   0.460)*                                                                              *
   0.440)*                                      *                   *                   *
   0.420)                   *                   ***                                     **
   0.400)*                                      *                   *
   0.380)*                                      *                   **                  **
   0.360)*                  **                  **                  *
   0.340)**                 *                   **                  ****                *
   0.320)***                ***                 ***                 ***
   0.300)********           ******              ********            ****
   0.280)****************** ******************  *****************   ******************  **********
   0.260)*****************26 *****************27 *****************27 *****************28 *****************37
   0.240)M****************53 *****************51 M****************44 *****************47 *****************46
   0.220)*****************39 M****************33 *****************32 M****************22 M****************39
   0.200)*****************41 *****************25 *****************32 *****************38 *****************35
   0.180)****************   *****************21 *****************32 *****************21 *****************28
   0.160)******             *****************28 ****************    ******************* *****************21
   0.140)****               *************       **********          *********           *************
   0.120)**                 *****               ***                 ******              *********
   0.100)****               *                   **                  *                   *****
   0.080)                                                           **                  **
   0.060)                                                           **
   0.040)*
   0.020)
   0.000)

MEAN          0.237              0.227              0.231              0.230              0.221
STD.DEV.      0.053              0.056              0.056              0.066              0.062
R.E.S.D.      0.046              0.052              0.053              0.058              0.054
S. E. M.      0.004              0.004              0.004              0.004              0.004
MAXIMUM       0.480              0.530              0.450              0.590              0.560
MINIMUM       0.050              0.100              0.110              0.060              0.090
SAMPLE SIZE     229                237                236                232                254
                          ****************************** ANALYSIS OF VARIANCE TABLE ******************************
                          *
  ALL GROUPS COMBINED     *   SOURCE              SUM OF SQUARES     DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                          *
MEAN             0.229    *   BETWEEN GROUPS          0.0310          4       0.0077       2.23          0.0634
STD.DEV.         0.059    *   WITHIN  GROUPS          4.0980       1183       0.0035
R.E.S.D.         0.053    *
S. E. M.         0.002    *   TOTAL                   4.1289       1187
MAXIMUM          0.590    ***************************************************************************************
MINIMUM          0.050
```

```
1978 ONEONTA POTENTIALS BY TREATMENT
       LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREAT
      ...................+...................+...................+...................+...................+
MIDPOINTS
   0.680)
   0.660)
   0.640)
   0.620)                                                                              *
   0.600)
   0.580)
   0.560)
   0.540)
   0.520)
   0.500)                  *
   0.480)                                                                              *
   0.460)                                                          *
   0.440)
   0.420)                  **
   0.400)                                      **                  *                   *
   0.380)                                                                              *
   0.360)                                      ***                 *
   0.340)*                                     *                   *                   *
   0.320)                  **                  *                   **
   0.300)*                 ***                 ***                 ****                **
   0.280)*                 *                   *****               ****
   0.260)************      *******             *****               ******************  ****
   0.240)*****************25 *****************23 *****************27 ******************  *****************20
   0.220)*****************29 *****************25 *****************24 *****************43 *****************32
   0.200)M****************52 *****************26 *****************34 M****************32 *****************32
   0.180)*****************40 M****************38 M****************32 *****************31 M****************50
   0.160)*****************33 *****************43 *****************34 *****************24 *****************43
   0.140)*****************   *****************   *****************26 ******************  *****************23
   0.120)********            ******************  *****************23 **************      *****************21
   0.100)****                ***************     *****               **********          ************
   0.080)*                   ************        ********            *******             ****
   0.060)**                  ***                 *                   *                   *****
   0.040)*                                       *                   **
   0.020)*

MEAN         0.194               0.184               0.190               0.198               0.186
STD.DEV.     0.044               0.061               0.058               0.060               0.061
R.E.S.D.     0.041               0.056               0.055               0.057               0.051
S. E. M.     0.003               0.004               0.004               0.004               0.004
MAXIMUM      0.350               0.520               0.410               0.480               0.620
MINIMUM      0.030               0.070               0.050               0.040               0.060
SAMPLE SIZE    228                 236                 235                 232                 253

                                ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                                *
  ALL GROUPS COMBINED           *    SOURCE                SUM OF SQUARES      DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                *
MEAN              0.190         *    BETWEEN GROUPS           0.0346           4       0.0087       2.64         0.0324
STD.DEV.          0.057         *    WITHIN  GROUPS           3.8630        1179       0.0033
R.E.S.D.          0.052         *
S. E. M.          0.002         *    TOTAL                    3.8496        1183
MAXIMUM           0.620         *****************************************************************************************
MINIMUM           0.030         *    LEVENE'S TEST FOR EQUAL VARIANCES      4,1179                  4.07         0.0028
SAMPLE SIZE        1184         *****************************************************************************************
                                *    WELCH                                  4, 587                  2.55         0.0385
                                *    BROWN-FORSYTHE                         4,1136                  2.66         0.0317
```

```
1979 ONEONTA POTENTIALS BY TREATMENT
        LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREAT
      ....................+...................+...................+...................+...................+
MIDPOINTS
   0.680)                                                                               *
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)                  *
   0.560)
   0.540)                                                          *                   *
   0.520)                                                          *
   0.500)                                                                              *
   0.480)
   0.460)                                                          *
   0.440)                                      *                                       **
   0.420)                                      *
   0.400)                  *                   *                   *
   0.380)                                                          **
   0.360)**                *                   **                  **
   0.340)                  **                  **                  *                   *
   0.320)**                ***                 **                  *******             *
   0.300)******            ***                 *****               ******              **
   0.280)********          ******              ******              ***********         ****
   0.260)**************    *************       **************      ***************     *********
   0.240)****************  ***************     ******************  *****************   ******************23
   0.220)******************29 ******************31 ******************32 ******************35 ******************35
   0.200)M*****************51 M*****************34 M*****************40 M*****************28 M*****************48
   0.180)******************51 ******************32 ******************34 ******************42 ******************36
   0.160)******************25 ******************29 ******************37 ******************25 ******************24
   0.140)**********        ******************31 ******************27 ************        ******************29
   0.120)***********       ******************  **********          ****************    ******************22
   0.100)*                 *********           ***                 ***********         **************
   0.080)***               ********            ***                 *                   **
   0.060)*                 *                                       **
   0.040)                  *                                       *
   0.020)

MEAN          0.204               0.192               0.203               0.210               0.197
STD.DEV.      0.047               0.063               0.057               0.071               0.069
R.E.S.D.      0.044               0.058               0.053               0.065               0.056
S. E. M.      0.003               0.004               0.004               0.005               0.004
MAXIMUM       0.380               0.590               0.440               0.540               0.680
MINIMUM       0.060               0.050               0.080               0.050               0.080
SAMPLE SIZE     228                 236                 235                 232                 253

                                 ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                                 *
  ALL GROUPS COMBINED            *   SOURCE            SUM OF SQUARES     DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                 *
MEAN              0.201          *   BETWEEN GROUPS        0.0451          4       0.0113        2.91         0.0207
STD.DEV.          0.062          *   WITHIN  GROUPS        4.5725       1179       0.0039
R.E.S.D.          0.055          *
S. E. M.          0.002          *   TOTAL                 4.6176       1183
MAXIMUM           0.680          ******************************************************************************************
MINIMUM           0.050          *   LEVENE'S TEST FOR EQUAL VARIANCES      4,1179                     4.41         0.0015
SAMPLE SIZE        1184          ******************************************************************************************
                                 *   WELCH
```

APPENDIX E

CORROSION POTENTIAL HISTOGRAMS AND ANALYSIS OF VARIANCE WITH EXCLUDED TREATMENTS (1976 DATA)

```
1976 ONEONTA POTENTIALS BY TREATMENT (EXCLUDING LINSEED OIL)

         LINSEED            AQUADRON            DEEPGARD            SEALCURE            UNTREATED
       ..................+...................+...................+...................+...................+
MIDPOINTS
   0.700)
   0.680)
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)
   0.560)
   0.540)
   0.520)
   0.500)
   0.480)
   0.460)
   0.440)                                                         *
   0.420)                                                                             *
   0.400)
   0.380)
   0.360)
   0.340)
   0.320)
   0.300)
   0.280)
   0.260)                   *                                                         *
   0.240)                   *                                     ***
   0.220)                   *                   ***               ****                ***
   0.200)                   *                   **                ****                *
   0.180)                   ****                ******            *****               ****
   0.160)                   **************      ****************20 *************      *************
   0.140)                   *****************32 ****************43 ****************38 ****************34
   0.120)                   *****************30 M***************37 M***************44 ****************47
   0.100)                   M****************46 ****************39 ****************34 M***************52
   0.080)                   *****************40 ****************33 ****************31 ****************39
   0.060)                   *****************34 ****************27 ****************23 ****************34
   0.040)                   ******************  ***************   ******************  *****************
   0.020)                   **********          *                 *****               ****
   0.000)                   **

MEAN          0.000            0.102               0.113               0.114               0.108
STD.DEV.      0.000            0.043               0.039               0.050               0.044
R.E.S.D.      0.000            0.043               0.041               0.047               0.041
S. E. M.      0.000            0.003               0.003               0.003               0.003
MAXIMUM       0.000            0.270               0.230               0.450               0.430
MINIMUM       0.000            0.000               0.020               0.020               0.020
SAMPLE SIZE     0                234                 226                 224                 250
                             ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                             *
  ALL GROUPS COMBINED        *   SOURCE              SUM OF SQUARES     DF    MEAN SQUARE   F VALUE   TAIL PROBABILITY
                             *
MEAN             0.109       *   BETWEEN GROUPS          0.0201          3      0.0067       3.39         0.0175
STD.DEV.         0.045       *   WITHIN  GROUPS          1.8315        930      0.0020
R.E.S.D.         0.043       *
S. E. M.         0.001       *   TOTAL                   1.8516        933
MAXIMUM          0.450       ***************************************************************************************
MINIMUM          0.000       *   LEVENE'S TEST FOR EQUAL VARIANCES    3, 930                  1.81         0.1845
```

```
1976 ONEONTA POTENTIALS BY TREATMENT (EXCLUDING AQUADRON)

         LINSEED             AQUADRON             DEEPGARD             SEALCURE             UNTREATED
         ....................+....................+....................+....................+....................+
MIDPOINTS
   0.700)
   0.680)
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)
   0.560)
   0.540)
   0.520)
   0.500)
   0.480)
   0.460)
   0.440)                                                               *
   0.420)                                                                                    *
   0.400)
   0.380)
   0.360)
   0.340)
   0.320)
   0.300)*
   0.280)
   0.260)*                                                                                   *
   0.240)*                                                              ***
   0.220)******                                     ***                  ****                 ***
   0.200)******                                     **                   ****                 *
   0.180)***********                                ******               *****                ****
   0.160)******************31                       ******************20 *************        *************
   0.140)M*****************63                       ******************43 ******************38 ******************34
   0.120)******************47                       M*****************37 M*****************44 ******************47
   0.100)******************27                       ******************39 ******************34 M*****************52
   0.080)*************                              ******************33 ******************31 ******************39
   0.060)**************                             ******************27 ******************23 ******************34
   0.040)***                                        ***************      ******************** *****************
   0.020)*                                          *                    *****                ****
   0.000)***

MEAN          0.134                0.000                0.113                0.114                0.108
STD.DEV.      0.043                0.000                0.039                0.050                0.044
R.E.S.D.      0.040                0.000                0.041                0.047                0.041
S. E. M.      0.003                0.000                0.003                0.003                0.003
MAXIMUM       0.300                0.000                0.230                0.450                0.430
MINIMUM       0.000                0.000                0.020                0.020                0.020
SAMPLE SIZE     228                    0                  226                  224                  250
                                ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                                *
  ALL GROUPS COMBINED           *    SOURCE               SUM OF SQUARES       DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                *
MEAN                0.117       *    BETWEEN GROUPS           0.0883          3       0.0294      14.97         0.0000
STD.DEV.            0.045       *    WITHIN  GROUPS           1.8172        924       0.0020
R.E.S.D.            0.043       *
S. E. M.            0.001       *    TOTAL                    1.9056        927
MAXIMUM             0.450       ****************************************************************************************
MINIMUM             0.000       *    LEVENE'S TEST FOR EQUAL VARIANCES      3, 924                    1.93         0.1232
SAMPLE SIZE           928       ****************************************************************************************
```

```
1976 ONEONTA POTENTIALS BY TREATMENT (EXCLUDING DEEPGARD)

         LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREATED
         ....................+...................+...................+...................+...................+
MIDPOINTS
   0.700)
   0.680)
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)
   0.560)
   0.540)
   0.520)
   0.500)
   0.480)
   0.460)
   0.440)                                                             *
   0.420)                                                                                 *
   0.400)
   0.380)
   0.360)
   0.340)
   0.320)
   0.300)*
   0.280)
   0.260)*                    *                                                           *
   0.240)*                    *                                       ***
   0.220)******               *                                       ****                ***
   0.200)******               *                                       ****                *
   0.180)***********          ****                                    *****               ****
   0.160)*****************31  **************                          *************       *************
   0.140)M****************63  *****************32                     *****************38 *****************34
   0.120)*****************47  *****************30                     M****************44 *****************47
   0.100)*****************27  M****************46                     *****************34 M****************52
   0.080)*************        *****************40                     *****************31 *****************39
   0.060)**************       *****************34                     *****************23 *****************34
   0.040)***                  ******************                      ******************* *****************
   0.020)*                    **********                              *****               ****
   0.000)***                  **

MEAN          0.134               0.102               0.000               0.114               0.108
STD.DEV.      0.043               0.043               0.000               0.050               0.044
R.E.S.D.      0.040               0.043               0.000               0.047               0.041
S. E. M.      0.003               0.003               0.000               0.003               0.003
MAXIMUM       0.300               0.270               0.000               0.450               0.430
MINIMUM       0.000               0.000               0.000               0.020               0.020
SAMPLE SIZE     228                 234                   0                 224                 250
                                  ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                                  *
 - ALL GROUPS COMBINED            *    SOURCE                SUM OF SQUARES      DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                  *
MEAN                 0.114        *    BETWEEN GROUPS            0.1288           3       0.0429      21.11           0.0000
STD.DEV.             0.047        *    WITHIN  GROUPS            1.8962         932       0.0020
R.E.S.D.             0.045        *
S. E. M.             0.002        *    TOTAL                     2.0251         935
MAXIMUM              0.450        ******************************************************************************************
MINIMUM              0.000        *    LEVENE'S TEST FOR EQUAL VARIANCES        3, 932                [illegible]   [illegible]
```

```
1976 ONEONTA POTENTIALS BY TREATMENT (EXCLUDING SEALCURE)

          LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREATED
          ...................+...................+...................+...................+...................+
MIDPOINTS
    0.700)
    0.680)
    0.660)
    0.640)
    0.620)
    0.600)
    0.580)
    0.560)
    0.540)
    0.520)
    0.500)
    0.480)
    0.460)
    0.440)
    0.420)                                                                                *
    0.400)
    0.380)
    0.360)
    0.340)
    0.320)
    0.300)*
    0.280)
    0.260)*                   *                                                           *
    0.240)*                   *
    0.220)******              *                   ***                                     ***
    0.200)******              *                   **                                      *
    0.180)***********         ****                ******                                  ****
    0.160)*****************31 **************      *****************20                     *************
    0.140)M****************63 *****************32 *****************43                     *****************34
    0.120)*****************47 *****************30 M****************37                     *****************47
    0.100)*****************27 M****************46 *****************39                     M****************52
    0.080)*************       *****************40 *****************33                     *****************39
    0.060)**************      *****************34 *****************27                     *****************34
    0.040)***                 ******************  ***************                         *****************
    0.020)*                   **********          *                                       ****
    0.000)***                 **

MEAN         0.134               0.102               0.113               0.000               0.108
STD.DEV.     0.043               0.043               0.039               0.000               0.044
R.E.S.D.     0.040               0.043               0.041               0.000               0.041
S. E. M.     0.003               0.003               0.003               0.000               0.003
MAXIMUM      0.300               0.270               0.230               0.000               0.430
MINIMUM      0.000               0.000               0.020               0.000               0.020
SAMPLE SIZE    228                 234                 226                   0                 250
                                   ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                                   *
  ALL GROUPS COMBINED              *   SOURCE            SUM OF SQUARES     DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                   *
MEAN                 0.114         *   BETWEEN GROUPS        0.1290          3       0.0430       23.87         0.0000
STD.DEV.             0.044         *   WITHIN  GROUPS        1.6822        934       0.0018
R.E.S.D.             0.043         *
S. E. M.             0.001         *   TOTAL                 1.8112        937
MAXIMUM              0.430         ******************************************************************************************
MINIMUM              0.000         *   LEVENE'S TEST FOR EQUAL VARIANCES   3, 934                      0.41          0.7423
SAMPLE SIZE            938         ******************************************************************************************
```

```
1976 ONEONTA POTENTIALS BY TREATMENT (EXCLUDING UNTREATED)

         LINSEED             AQUADRON            DEEPGARD            SEALCURE            UNTREATED
        ...................+...................+...................+...................+...................+
MIDPOINTS
   0.700)
   0.680)
   0.660)
   0.640)
   0.620)
   0.600)
   0.580)
   0.560)
   0.540)
   0.520)
   0.500)
   0.480)
   0.460)
   0.440)                                                           *
   0.420)
   0.400)
   0.380)
   0.360)
   0.340)
   0.320)
   0.300)*
   0.280)
   0.260)*                   *
   0.240)*                   *                                      ***
   0.220)******              *                   ***                ****
   0.200)******              *                   **                 ****
   0.180)***********         ****                ******             *****
   0.160)*****************31 **************      *****************20 *************
   0.140)M****************63 *****************32 *****************43 *****************38
   0.120)*****************47 *****************30 M****************37 M****************44
   0.100)*****************27 M****************46 *****************39 *****************34
   0.080)*************       *****************40 *****************33 *****************31
   0.060)**************      *****************34 *****************27 *****************23
   0.040)***                 ******************  ***************     *******************
   0.020)*                   **********          *                   *****
   0.000)***                 **

MEAN          0.134               0.102               0.113               0.114               0.000
STD.DEV.      0.043               0.043               0.039               0.050               0.000
R.E.S.D.      0.040               0.043               0.041               0.047               0.000
S. E. M.      0.003               0.003               0.003               0.003               0.000
MAXIMUM       0.300               0.270               0.230               0.450               0.000
MINIMUM       0.000               0.000               0.020               0.020               0.000
SAMPLE SIZE   228                 234                 226                 224                 0
                                    ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
                                    *
  ALL GROUPS COMBINED               *    SOURCE              SUM OF SQUARES      DF    MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                    *
MEAN              0.116             *    BETWEEN GROUPS          0.1178           3      0.0393        20.24         0.0000
STD.DEV.          0.045             *    WITHIN  GROUPS          1.7614         908      0.0019
R.E.S.D.          0.045             *
S. E. M.          0.002             *    TOTAL                   1.8791         911
MAXIMUM           0.450             ***************************************************************************************
MINIMUM           0.000             *    LEVENE'S TEST FOR EQUAL VARIANCES     3, 908                   1.93          0.1225
```

APPENDIX F

CHLORIDE ION CONCENTRATION DATA (1976-1977)
AND
ANALYSIS OF VARIANCE MODELS (1973 CORES, 1976-1977 SURVEYS)

ONEONTA BRIDGE NO. 3 - ALL SPANS

CHLORIDE ION CONCENTRATIONS (lb/yd^3) BY TREATMENT AT DEPTH INDICATED

YEAR	LINSEED OIL			AQUADRON			DEEPGARD			SEALCURE			UNTREATED		
	1"	2"	3"	1"	2"	3"	1"	2"	3"	1"	2"	3"	1"	2"	3"
1976	0.98	0.86	0.37	1.72	0.62	0.37	0.72	0.72	0.49	0.99	0.86	0.86	3.20	0.86	0.86
	0.98	0.74	0.49	0.62	0.37	0.37	0.97	0.85	0.61	2.18	1.82	0.77	0.50	0.25	0.25
	0.62	0.37	0	1.09	0.85	0.61	0.12	0.12	0	0.96	0.84	0.72	0.50	0.50	0.25
	0.49	0.37	0.37	2.27	0	0	0.98	0.61	0.25	1.56	0.84	0.60	1.08	0.48	0.24
	0.98	0.73	0.49												
	0.98	0.98	0.49												
	0	0	0												
	0.25	0	0												
Avg.	0.66	0.51	0.28	1.43	0.46	0.34	0.70	0.46	0.34	1.42	1.09	0.74	1.32	0.52	0.40
1977	0.49	0.12	0.12	1.23	0.49	0.12	1.97	0.62	0.37	1.36	0.74	0.37	1.97	0.62	0.37
	0.12	0.12	0.12	1.97	0.12	0.12	0.86	0.74	0.49	0.86	0.74	0.12	2.71	0.12	0.12
	1.23	0.12	0.12	1.60	0.74	0.62	0.74	0.37	0.12	1.97	0.86	0.12	2.84	0.37	0.12
	0.12	0.12	0.12	1.23	0.49	0.37	0.61	0.36	0.12	0.61	0.36	0.12	1.72	0.37	0.12
	0.36	0.12	0.12	2.42	0.49	0.12	0.97	0.12	0.12	0.72	0.49	0.12	2.66	0.12	0.12
	0.85	0.72	0.12	0.12	0.12	0.12	0.12	0.12	0.12	1.59	0.13	0.12	0.12	0.12	0.12
	0.61	0.49	0.12	0.49	0.36	0.12	0.61	0.36	0.12	0.61	0.36	0.12	1.22	0.49	0.12
	1.00	0.75	0.13	1.00	0.13	0.13	0.13	0.13	0.15	0.50	0.13	0.13	2.32	0.12	0.12
	1.00	0.75	0.13	0.50	0.13	0.13	1.00	0.75	0.13	0.50	0.38	0.13	0.13	0.13	0.13
	0.60	0.36	0.12	2.39	0.72	0.36	0.72	0.72	0.60	2.03	0.60	0.60	0.13	0.13	0.13
	0.72	0.48	0.36	0.85	0.60	0.36	0.72	0.60	0.12	3.50	0.72	0.36	0.96	0.72	0.72
													1.67	0.72	0.36
Avg.	0.65	0.37	0.14	1.25	0.40	0.23	0.77	0.44	0.22	1.25	0.50	0.21	1.54	0.34	0.21

```
1PAGE   4  BMDP7D 1973 CHLORIDES FROM CORES

             ************                                                        ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT    * (VARIABLE    1)
             ************                                                        ************

           LINSEED          AQUADRON          DEEPGARD          SEALCURE          UNTREAT
           ................+.................+.................+.................+.................
MIDPOINTS
   4.200)
   4.000)
   3.800)
   3.600)
   3.400)
   3.200)
   3.000)
   2.800)
   2.600)
   2.400)
   2.200)
   2.000)
   1.800)
   1.600)
   1.400)
   1.200)
   1.000)                                *                 *
   0.800)*               *                                 *
   0.600)M               M**             M**               N                 M***
   0.400)****            **              **                **                **
   0.200)                                                  *
   0.000)
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

MEAN          0.533          0.600          0.633          0.600          0.550
STD.DEV.      0.151          0.190          0.207          0.308          0.084
R.E.S.D.      0.153          0.183          0.198          0.336          0.092
S. E. M.      0.061          0.077          0.084          0.138          0.034
MAXIMUM       0.800          0.900          1.000          1.000          0.600
MINIMUM       0.400          0.400          0.400          0.200          0.400
SAMPLE SIZE       6              6              6              5              6

      ALL GROUPS COMBINED        *******************************  ANALYSIS OF VARIANCE TABLE  *******************************
(EXCEPT CASES WITH UNUSED VALUES *
  FOR TREAT   )                  *    SOURCE              SUM OF SQUARES     DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                 *
MEAN              0.583          *    BETWEEN GROUPS           0.0397          4       0.0099       0.26          0.9016
STD.DEV.          0.185          *    WITHIN  GROUPS           0.9217         24       0.0384
R.E.S.D.          0.174          *
S. E. M.          0.034          *    TOTAL                    0.9614         28
MAXIMUM           1.000          ***************************************************************************************
MINIMUM           0.200          *    LEVENE'S TEST FOR EQUAL VARIANCES     4,  24                    1.74          0.1750
SAMPLE SIZE          29          ***************************************************************************************
                                 *    ONE-WAY ANALYSIS OF VARIANCE
                                 *    TEST STATISTICS FOR WITHIN-GROUP
                                 *    VARIANCES NOT ASSUMED TO BE EQUAL
                                 *       WELCH                          4,  11                    0.29          0.8780
                                 *       BROWN-FORSYTHE                 4,  13                    0.24          0.9098
```

```
1PAGE    4  BMDP7D 1976 CHLORIDES @ 1 INCH

              ************                                                                ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT    * (VARIABLE     1)
              ************                                                                ************

         LINSEED          AQUADRON          DEEPGARD          SEALCURE          UNTREAT
        ................+.................+.................+.................+................
MIDPOINTS
   4.200)
   4.000)
   3.800)
   3.600)
   3.400)
   3.200)
   3.000)                                                                       *
   2.800)
   2.600)
   2.400)
   2.200)                *
   2.000)                                                    *
   1.800)
   1.600)                *
   1.400)                N                                   M
   1.200)                                                                       N
   1.000)****            *                 **                **                 *
   0.800)
   0.600)M               *                 M
   0.400)*                                                                      **
   0.200)*                                 *
   0.000)*
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

MEAN           0.660            1.425             0.698             1.423             1.320
STD.DEV.       0.386            0.721             0.403             0.576             1.283
R.E.S.D.       0.429            0.825             0.418             0.648             1.360
S. E. M.       0.137            0.361             0.202             0.288             0.641
MAXIMUM        0.980            2.270             0.980             2.180             3.200
MINIMUM        0.000            0.620             0.120             0.960             0.500
SAMPLE SIZE        8                4                 4                 4                 4

       ALL GROUPS COMBINED           ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
 (EXCEPT CASES WITH UNUSED VALUES    *
   FOR TREAT    )                    *    SOURCE               SUM OF SQUARES     DF    MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                     *
MEAN                 1.031           *    BETWEEN GROUPS           3.1141          4      0.7785        1.64          0.2056
STD.DEV.             0.726           *    WITHIN  GROUPS           9.0237         19      0.4749
R.E.S.D.             0.628           *
S. E. M.             0.148           *    TOTAL                   12.1378         23
MAXIMUM              3.200           ***************************************************************************************
MINIMUM              0.000           *    LEVENE'S TEST FOR EQUAL VARIANCES    4,  19                       2.62          0.0673
SAMPLE SIZE             24           ***************************************************************************************
                                     *    ONE-WAY ANALYSIS OF VARIANCE
                                     *    TEST STATISTICS FOR WITHIN-GROUP
                                     *    VARIANCES NOT ASSUMED TO BE EQUAL
                                     *       WELCH                         4,    7                      1.87          0.2198
                                     *       BROWN-FORSYTHE                4,    7                      1.34          0.3428
```

1PAGE 4 BMDP7D 1976 CHLORIDES @ 2 INCH

```
               ************                                                                ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT    * (VARIABLE    1)
               ************                                                                ************

          LINSEED          AQUADRON         DEEPGARD         SEALCURE         UNTREAT
        ...............+...............+...............+...............+...............
MIDPOINTS
   4.200)
   4.000)
   3.800)
   3.600)
   3.400)
   3.200)
   3.000)
   2.800)
   2.600)
   2.400)
   2.200)
   2.000)
   1.800)                                                 *
   1.600)
   1.400)
   1.200)
   1.000)*                                                N
   0.800)**              *                *               ***              *
   0.600)*               *                M*
   0.400)M*              M                                                 M*
   0.200)                                 *                                *
   0.000)**              *
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE
```

	LINSEED	AQUADRON	DEEPGARD	SEALCURE	UNTREAT
MEAN	0.506	0.460	0.575	1.090	0.523
STD.DEV.	0.379	0.364	0.319	0.487	0.252
R.E.S.D.	0.430	0.398	0.329	0.528	0.244
S. E. M.	0.134	0.182	0.159	0.243	0.126
MAXIMUM	0.980	0.850	0.850	1.820	0.860
MINIMUM	0.000	0.000	0.120	0.840	0.250
SAMPLE SIZE	8	4	4	4	4

ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES FOR TREAT)

MEAN	0.610
STD.DEV.	0.403
R.E.S.D.	0.388
S. E. M.	0.082
MAXIMUM	1.820
MINIMUM	0.000
SAMPLE SIZE	24

****************************** ANALYSIS OF VARIANCE TABLE ******************************

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	1.1332	4	0.2833	2.06	0.1258
WITHIN GROUPS	2.6076	19	0.1372		
TOTAL	3.7408	23			
LEVENE'S TEST FOR EQUAL VARIANCES		4, 19		0.78	0.5501
ONE-WAY ANALYSIS OF VARIANCE TEST STATISTICS FOR WITHIN-GROUP VARIANCES NOT ASSUMED TO BE EQUAL					
WELCH		4, 8		1.06	0.4336
BROWN-FORSYTHE		4, 13		2.09	0.1399

1PAGE 4 BMDP7D 1976 CHLORIDES @ 3 INCH

```
         ************                                                               ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT      * (VARIABLE     1)
         ************                                                               ************

        LINSEED          AQUADRON          DEEPGARD          SEALCURE          UNTREAT
       .................+.................+.................+.................+................
MIDPOINTS
   4.200)
   4.000)
   3.800)
   3.600)
   3.400)
   3.200)
   3.000)
   2.800)
   2.600)
   2.400)
   2.200)
   2.000)
   1.800)
   1.600)
   1.400)
   1.200)
   1.000)
   0.800)                                                M*                *
   0.600)               *                 *              **
   0.400)*****          M*                M                                N
   0.200)N                                *                                ***
   0.000)***            *                 *
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE
```

	LINSEED	AQUADRON	DEEPGARD	SEALCURE	UNTREAT
MEAN	0.276	0.338	0.338	0.738	0.400
STD.DEV.	0.234	0.252	0.270	0.108	0.307
R.E.S.D.	0.278	0.244	0.308	0.112	0.333
S. E. M.	0.083	0.126	0.135	0.054	0.153
MAXIMUM	0.490	0.610	0.610	0.860	0.860
MINIMUM	0.000	0.000	0.000	0.600	0.240
SAMPLE SIZE	8	4	4	4	4

ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES
FOR TREAT)

MEAN	0.394
STD.DEV.	0.273
R.E.S.D.	0.283
S. E. M.	0.056
MAXIMUM	0.860
MINIMUM	0.000
SAMPLE SIZE	24

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	0.6086	4	0.1521	2.60	0.0687
WITHIN GROUPS	1.1104	19	0.0584		
TOTAL	1.7190	23			
LEVENE'S TEST FOR EQUAL VARIANCES		4, 19		1.25	0.3239
ONE-WAY ANALYSIS OF VARIANCE TEST STATISTICS FOR WITHIN-GROUP VARIANCES NOT ASSUMED TO BE EQUAL					
WELCH		4, 8		5.82	0.0171
BROWN-FORSYTHE		4, 13		2.55	0.0892

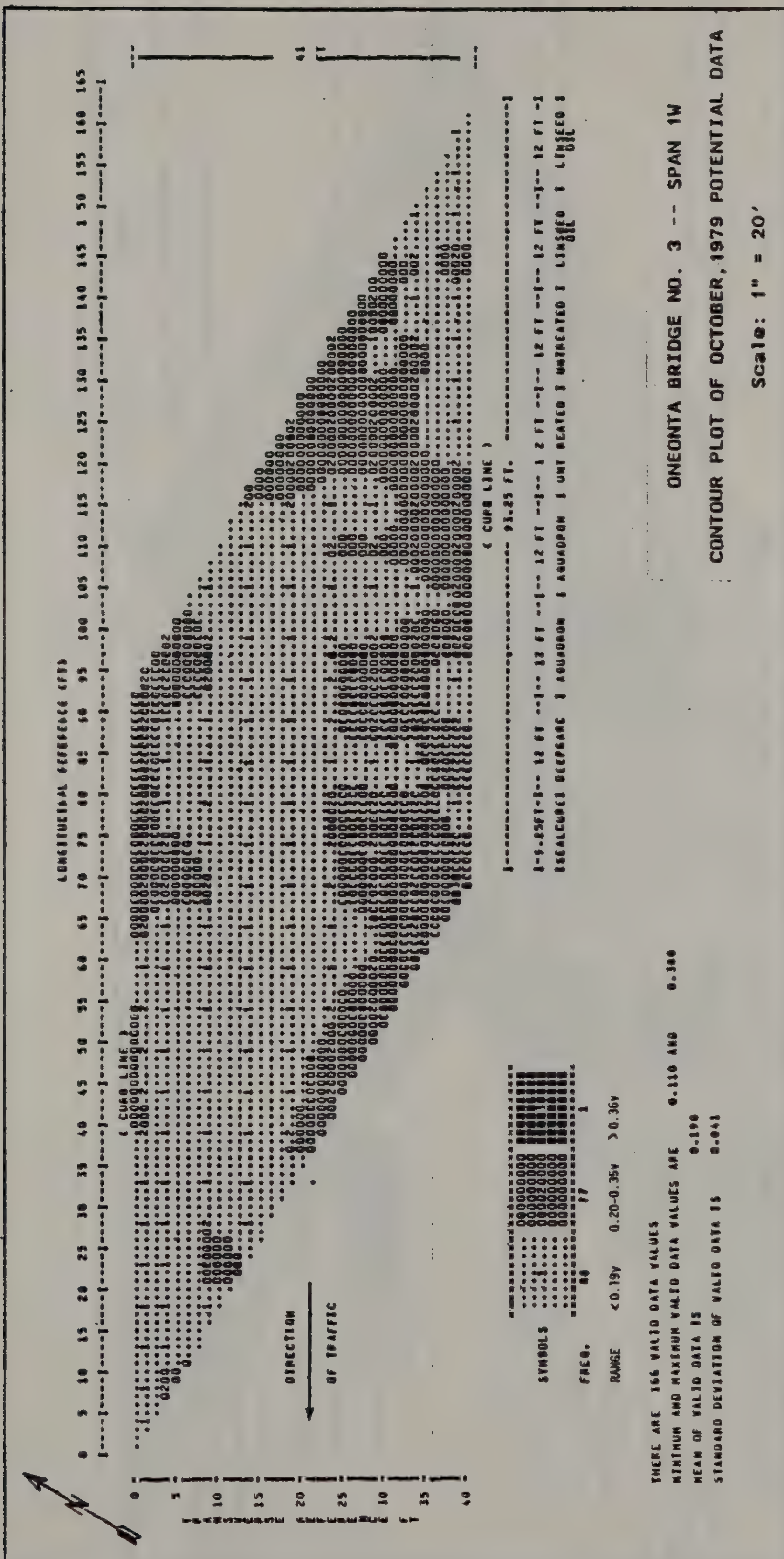
```
1PAGE    4  BMDP7D 1977 CHLORIDES @ 1 INCH

               ************                                                         ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT      * (VARIABLE    1)
               ************                                                         ************

         LINSEED          AQUADRON         DEEPGARD         SEALCURE         UNTREAT
         ................+................+................+................+................
MIDPOINTS
   4.200)
   4.000)
   3.800)
   3.600)
   3.400)                                                   *
   3.200)
   3.000)
   2.800)                                                                    *
   2.600)                                                                    **
   2.400)                 *
   2.200)                 *                                                  *
   2.000)                                                   *
   1.800)                 *                *                *                *
   1.600)                 *                                 *                **
   1.400)                                                                    N
   1.200)*                M*                                M                *
   1.000)**               *                **                                *
   0.800)*                *                M*               *
   0.600)M**                               ****             ***
   0.400)**               **                                **
   0.200)**               *                **                                ***
   0.000)
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

MEAN         0.645            1.254            0.768            1.295            1.538
STD.DEV.     0.361            0.772            0.493            0.931            1.026
R.E.S.D.     0.376            0.804            0.413            0.949            1.119
S. E. M.     0.109            0.233            0.149            0.281            0.296
MAXIMUM      1.230            2.420            1.970            3.500            2.840
MINIMUM      0.120            0.120            0.120            0.500            0.120
SAMPLE SIZE     11               11               11               11               12

      ALL GROUPS COMBINED         ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
(EXCEPT CASES WITH UNUSED VALUES  *
  FOR TREAT    )                  *    SOURCE              SUM OF SQUARES    DF    MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                  *
MEAN             1.108            *    BETWEEN GROUPS          6.4572         4       1.6143       2.75          0.0380
STD.DEV.         0.814            *    WITHIN  GROUPS         29.9482        51       0.5872
R.E.S.D.         0.828            *
S. E. M.         0.109            *    TOTAL                  36.4053        55
MAXIMUM          3.500            ***************************************************************************************
MINIMUM          0.120            *    LEVENE'S TEST FOR EQUAL VARIANCES    4,  51                     3.89          0.0078
SAMPLE SIZE         56            ***************************************************************************************
                                  *    ONE-WAY ANALYSIS OF VARIANCE
                                  *    TEST STATISTICS FOR WITHIN-GROUP
                                  *    VARIANCES NOT ASSUMED TO BE EQUAL
                                  *       WELCH                         4,  25                     3.41          0.0234
                                  *       BROWN-FORSYTHE                4,  38                     2.80          0.0392
```

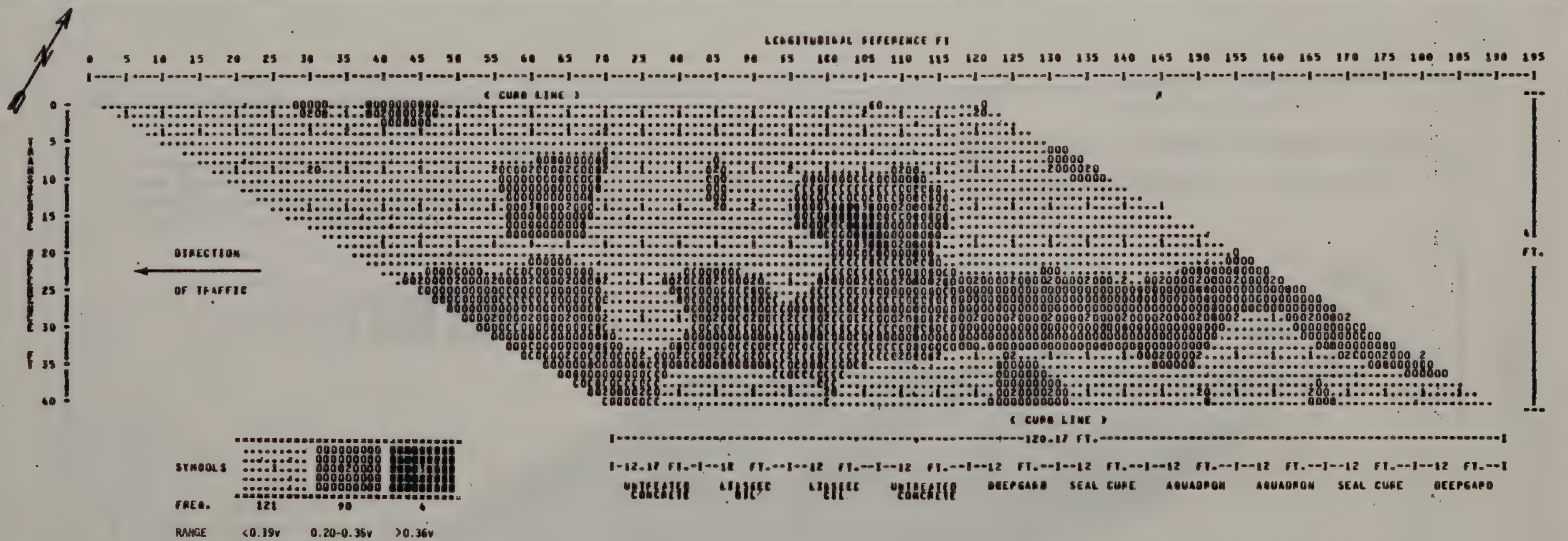
```
1PAGE   4  BMDP7D 1977 CHLORIDES @ 2 INCH

               ************                                                      ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT     * (VARIABLE    1)
               ************                                                      ************

          LINSEED            AQUADRON           DEEPGARD           SEALCURE           UNTREAT
         ..................+..................+..................+..................+..................
MIDPOINTS
    4.200)
    4.000)
    3.800)
    3.600)
    3.400)
    3.200)
    3.000)
    2.800)
    2.600)
    2.400)
    2.200)
    2.000)
    1.800)
    1.600)
    1.400)
    1.200)
    1.000)
    0.800)**                *                  **                 ***
    0.600)*                 **                 ***                **                 ***
    0.400)M**               M***               M**                M***               M**
    0.200)*****             ****               ***                **                 ******
    0.000)
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

MEAN          0.377              0.399              0.445              0.501              0.336
STD.DEV.      0.274              0.242              0.253              0.251              0.247
R.E.S.D.      0.312              0.271              0.289              0.276              0.278
S. E. M.      0.083              0.073              0.076              0.076              0.071
MAXIMUM       0.750              0.740              0.750              0.860              0.720
MINIMUM       0.120              0.120              0.120              0.130              0.120
SAMPLE SIZE      11                 11                 11                 11                 12

      ALL GROUPS COMBINED            ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
(EXCEPT CASES WITH UNUSED VALUES     *
  FOR TREAT    )                     *    SOURCE                 SUM OF SQUARES     DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                     *
MEAN              0.410              *    BETWEEN GROUPS             0.1831          4       0.0458        0.71          0.5878
STD.DEV.          0.251              *    WITHIN  GROUPS             3.2810         51       0.0643
R.E.S.D.          0.279              *
S. E. M.          0.034              *    TOTAL                      3.4641         55
MAXIMUM           0.860              ******************************************************************************************
MINIMUM           0.120              *    LEVENE'S TEST FOR EQUAL VARIANCES      4,  51                    0.13          0.9709
SAMPLE SIZE          56              ******************************************************************************************
                                     *    ONE-WAY ANALYSIS OF VARIANCE
                                     *    TEST STATISTICS FOR WITHIN-GROUP
                                     *    VARIANCES NOT ASSUMED TO BE EQUAL
                                     *       WELCH                           4,  25                    0.67          0.6168
                                     *       BROWN-FORSYTHE                  4,  50                    0.71          0.5884
```

```
1PAGE   4  BMDP7D 1977 CHLORIDES @ 3 INCH

                ************                                                  ************
HISTOGRAM OF * CHLORIDE * (VARIABLE    2). CASES DIVIDED INTO GROUPS BASED ON VALUES OF * TREAT    * (VARIABLE    1)
                ************                                                  ************

          LINSEED          AQUADRON          DEEPGARD          SEALCURE          UNTREAT
        ...............+...............+...............+...............+...............
MIDPOINTS
   4.200)
   4.000)
   3.800)
   3.600)
   3.400)
   3.200)
   3.000)
   2.800)
   2.600)
   2.400)
   2.200)
   2.000)
   1.800)
   1.600)
   1.400)
   1.200)
   1.000)
   0.800)
   0.600)               *                *                *                *
   0.400)*              ***              **               **               **
   0.200)M*********     M******          M*******         M*******         M********
   0.000)
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

MEAN          0.144            0.234            0.224            0.210            0.213
STD.DEV.      0.072            0.169            0.177            0.162            0.185
R.E.S.D.      0.052            0.185            0.189            0.167            0.177
S. E. M.      0.022            0.051            0.053            0.049            0.053
MAXIMUM       0.360            0.620            0.600            0.600            0.720
MINIMUM       0.120            0.120            0.120            0.120            0.120
SAMPLE SIZE      11               11               11               11               12

      ALL GROUPS COMBINED        ******************************  ANALYSIS OF VARIANCE TABLE  ******************************
(EXCEPT CASES WITH UNUSED VALUES  *
  FOR TREAT   )                   *    SOURCE              SUM OF SQUARES     DF     MEAN SQUARE   F VALUE   TAIL PROBABILITY
                                  *
MEAN              0.205           *    BETWEEN GROUPS          0.0552          4       0.0138        0.55         0.7028
STD.DEV.          0.156           *    WITHIN  GROUPS          1.2894         51       0.0253
R.E.S.D.          0.155           *
S. E. M.          0.021           *    TOTAL                   1.3446         55
MAXIMUM           0.720           ******************************************************************************************
MINIMUM           0.120           *    LEVENE'S TEST FOR EQUAL VARIANCES     4,  51                      2.54         0.0507
SAMPLE SIZE          56           ******************************************************************************************
                                  *    ONE-WAY ANALYSIS OF VARIANCE
                                  *    TEST STATISTICS FOR WITHIN-GROUP
                                  *    VARIANCES NOT ASSUMED TO BE EQUAL
                                  *       WELCH                          4,  24                      1.21         0.3310
                                  *       BROWN-FORSYTHE                 4,  44                      0.55         0.6994
```

APPENDIX G

CONTOUR PLOTS OF OCTOBER, 1979 CORROSION POTENTIAL DATA


ONEONTA BRIDGE NO. 3 -- SPAN 1W
CONTOUR PLOT OF OCTOBER, 1979 POTENTIAL DATA
Scale: 1" = 20'
LONGITUDINAL REFERENCE (FT)
DIRECTION OF TRAFFIC
(CURB LINE)
SYMBOLS
FREQ.
RANGE
<0.19v
0.20-0.35v
>0.36v

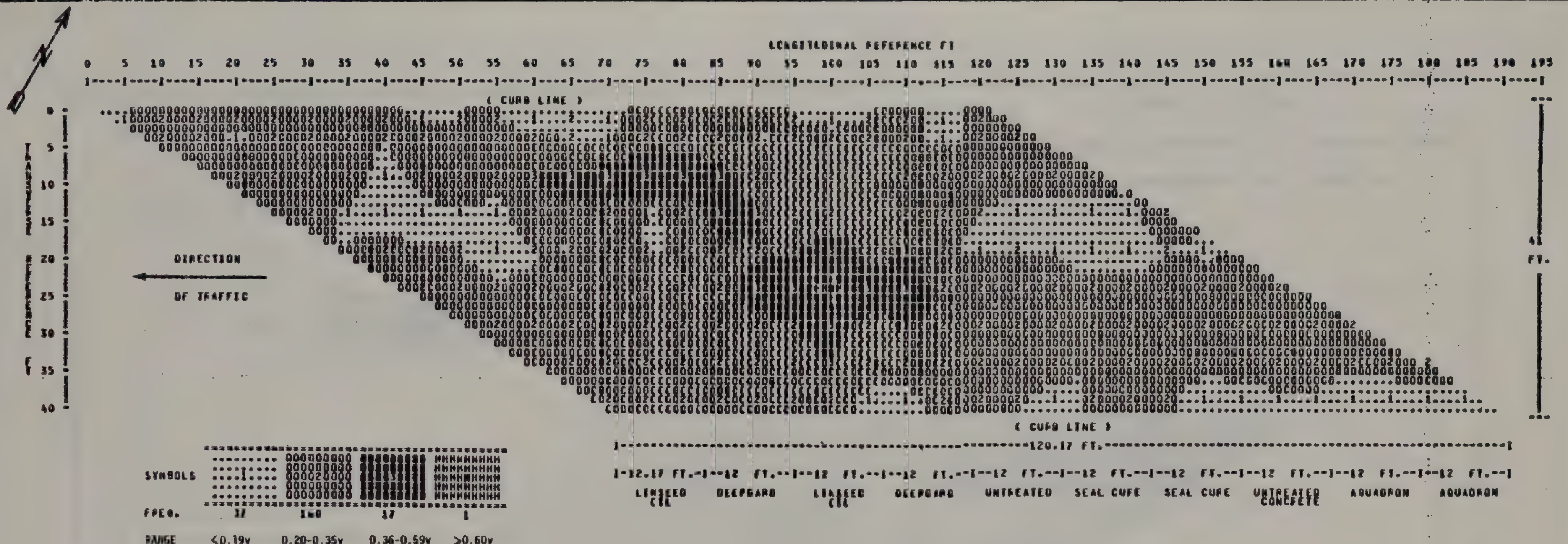


THERE ARE 215 VALID DATA VALUES
MINIMUM AND MAXIMUM VALID DATA VALUES ARE 0.110 AND 0.410
MEAN OF VALID DATA IS 0.194
STANDARD DEVIATION OF VALID DATA IS 0.048

ONEONTA BRIDGE NO. 3 -- SPAN 2W

CONTOUR PLOT OF OCTOBER, 1979 POTENTIAL DATA

Scale: 1" = 20'

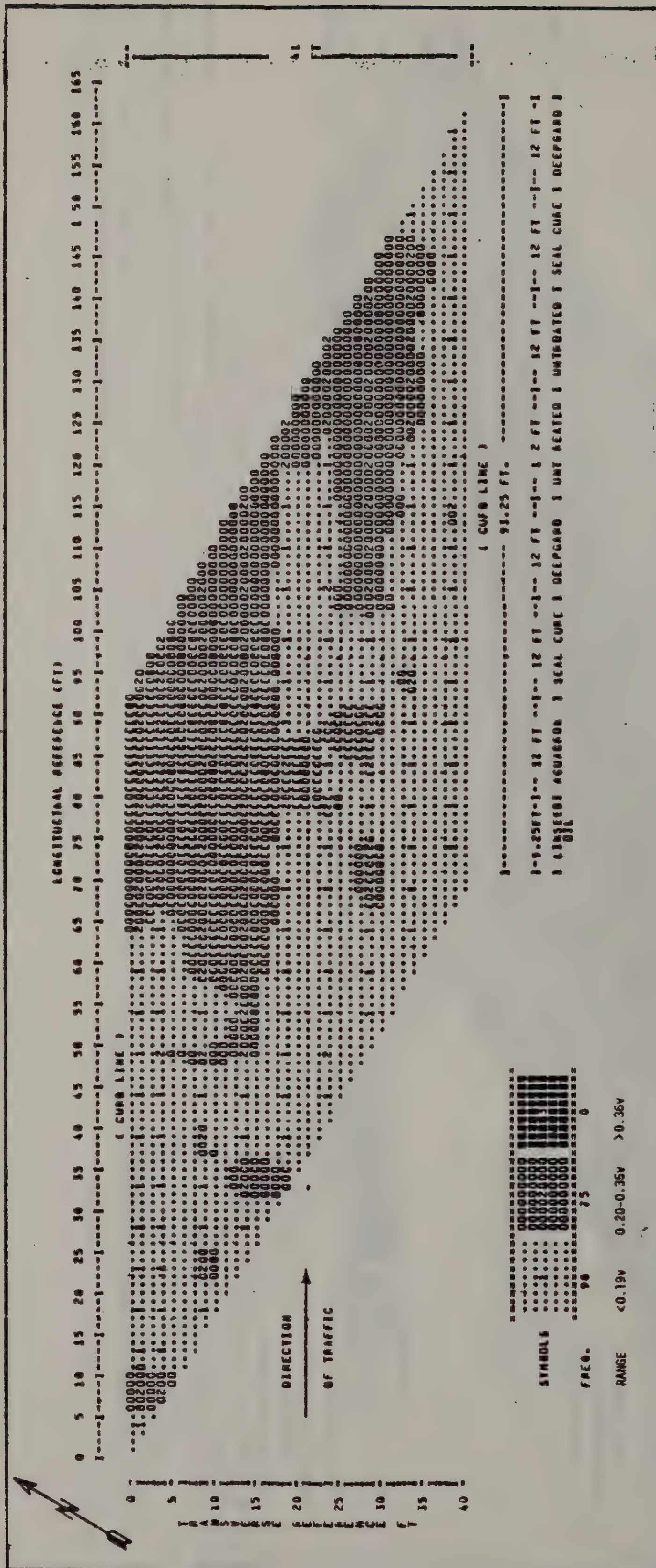


THERE ARE 215 VALID DATA VALUES
MINIMUM AND MAXIMUM VALID DATA VALUES ARE 0.130 AND 0.680
MEAN OF VALID DATA IS 0.252
STANDARD DEVIATION OF VALID DATA IS 0.079

ONEONTA BRIDGE NO. 3 -- SPAN 3W

CONTOUR PLOT OF OCTOBER, 1979 POTENTIAL DATA

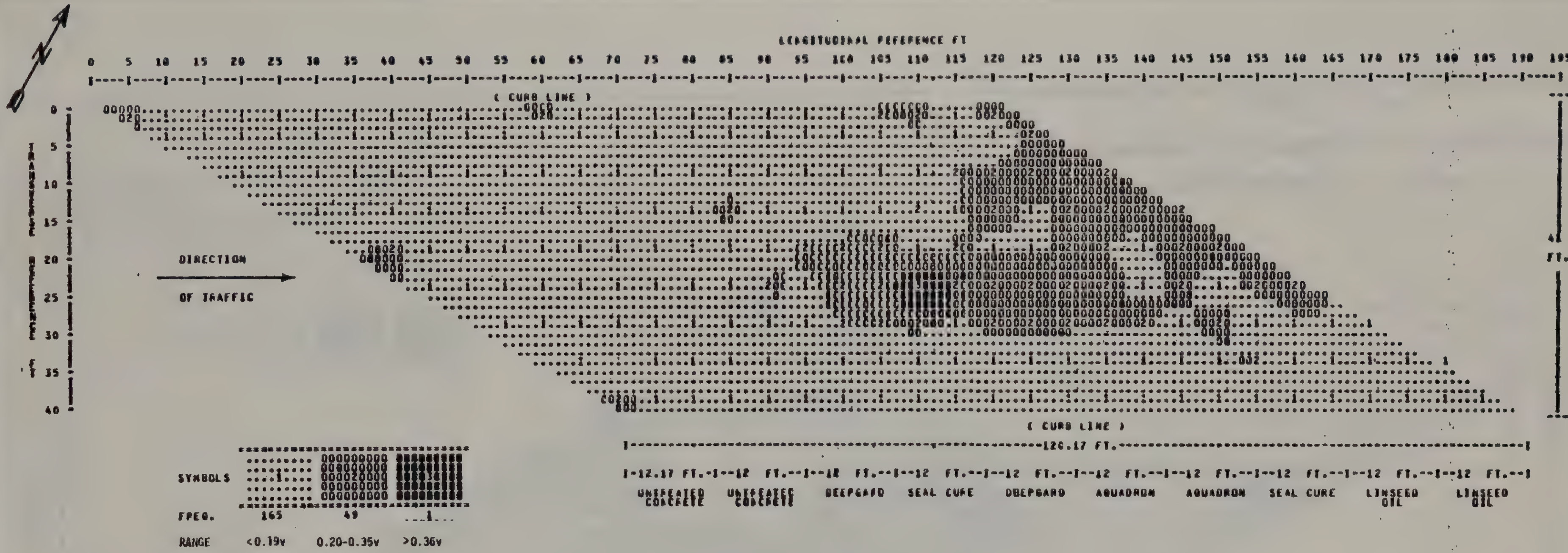
Scale: 1" = 20'



ONEONTA BRIDGE NO. 3 -- SPAN 1E

CONTOUR PLOT OF OCTOBER, 1979 POTENTIAL DATA

Scale: 1" = 20'

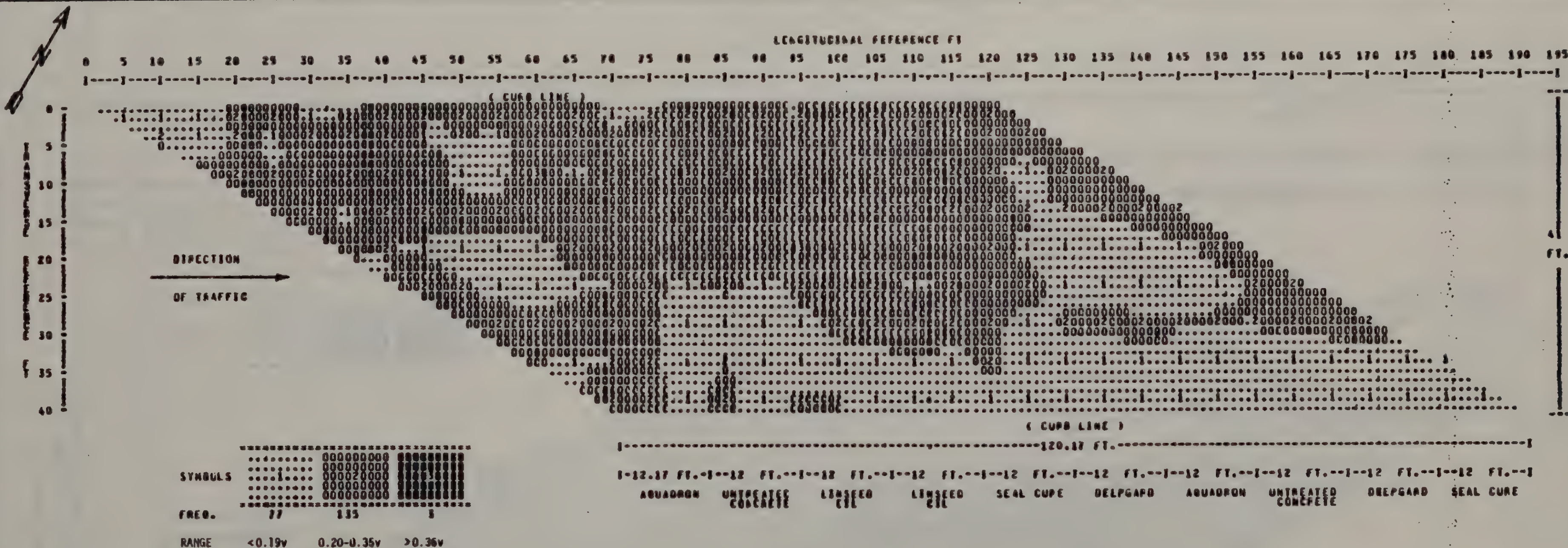


THERE ARE 215 VALID DATA VALUES
MINIMUM AND MAXIMUM VALID DATA VALUES ARE 0.058 AND 0.590
MEAN OF VALID DATA IS 0.161
STANDARD DEVIATION OF VALID DATA IS 0.060

ONEONTA BRIDGE NO. 3 -- SPAN 2E

CONTOUR PLOT OF OCTOBER, 1979 POTENTIAL DATA

Scale: 1" = 20'



THERE ARE 215 VALID DATA VALUES
MINIMUM AND MAXIMUM VALID DATA VALUES ARE 0.100 AND 0.380
MEAN OF VALID DATA IS 0.211
STANDARD DEVIATION OF VALID DATA IS 0.046

ONEONTA BRIDGE NO. 3 -- SPAN 3E

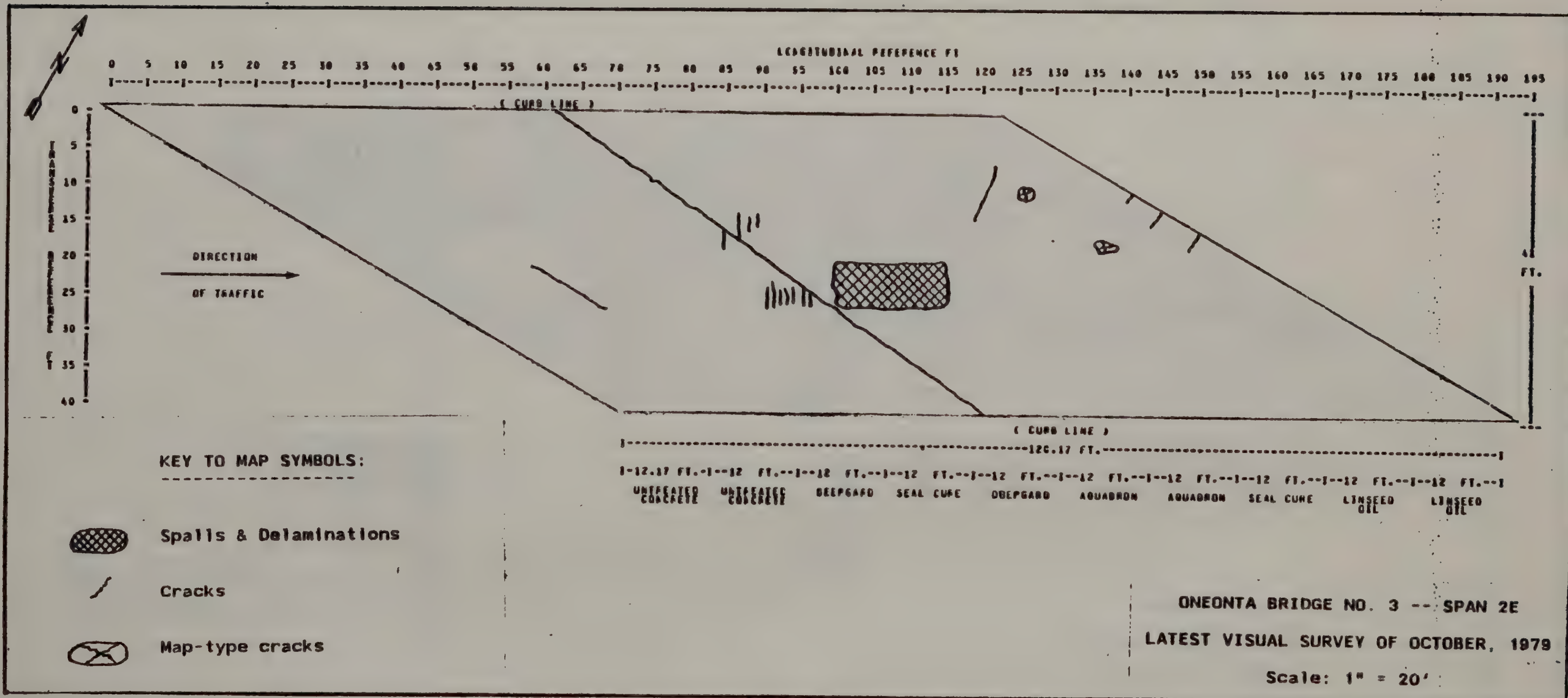
CONTOUR PLOT OF OCTOBER, 1979 POTENTIAL DATA

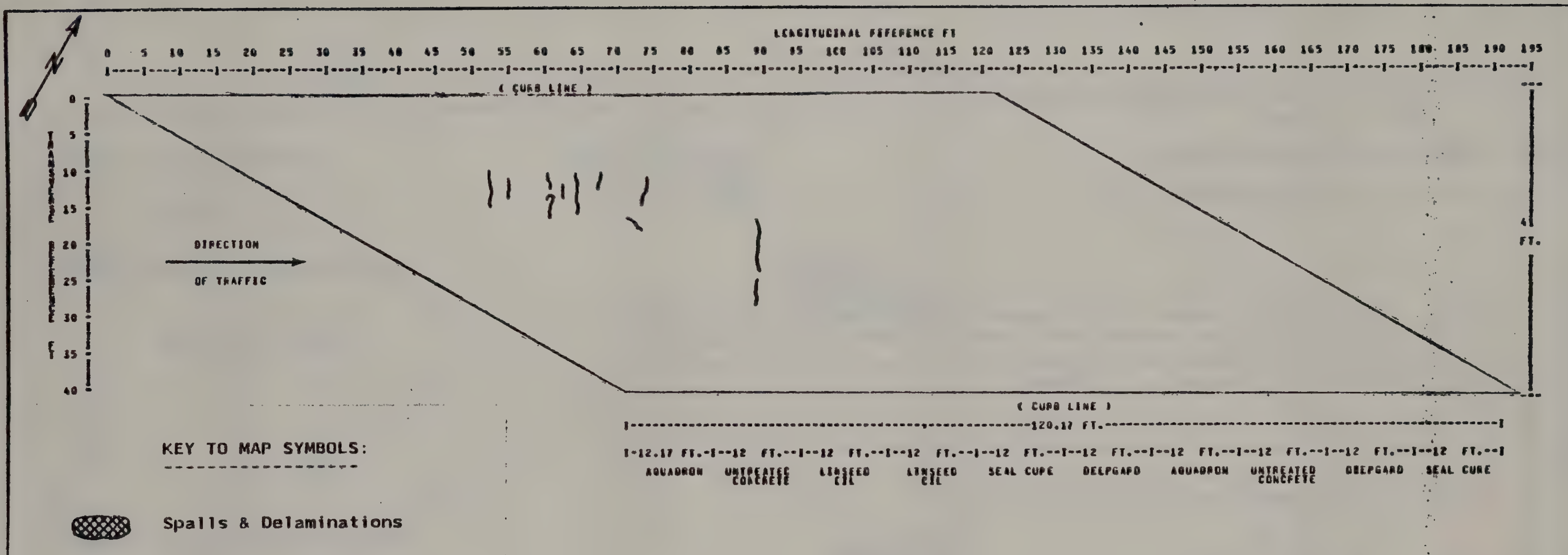
Scale: 1" = 20'

APPENDIX H

LATEST VISUAL SURVEY (1979) AND PHOTOGRAPHS (1979 AND 1982)

Note 1 Visual survey maps for Spans 1E & 1W not included.

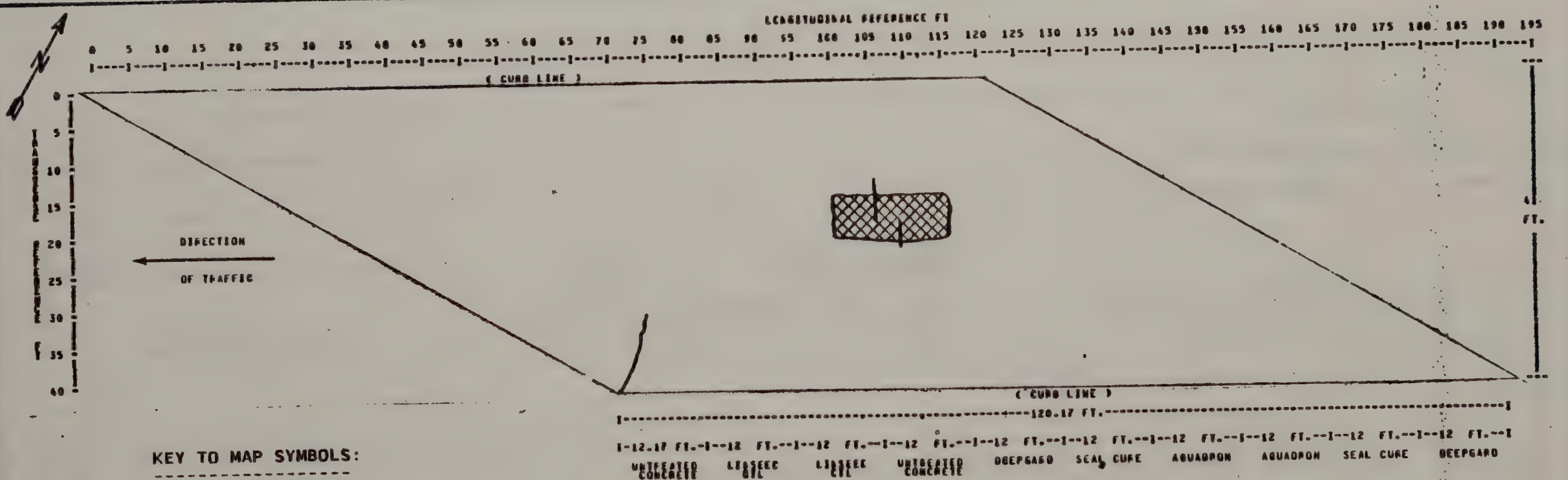

LONGITUDINAL REFERENCE FT
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195
TRANSVERSE REFERENCE FT
0 5 10 15 20 25 30 35 40
(CURB LINE)
DIRECTION
OF TRAFFIC
41 FT.
(CURB LINE)
126.17 FT.
12.17 FT. 12 FT. 12 FT. 12 FT. 12 FT. 12 FT. 12 FT. 12 FT. 12 FT. 12 FT.
UNTREATED CONCRETE
UNTREATED CONCRETE
DEEPGARD
SEAL CURE
DEEPGARD
AQUADRON
AQUADRON
SEAL CURE
LINSEED OIL
LINSEED OIL
KEY TO MAP SYMBOLS:
Spalls & Delaminations
Cracks
Map-type cracks
ONEONTA BRIDGE NO. 3 -- SPAN 2E
LATEST VISUAL SURVEY OF OCTOBER, 1979
Scale: 1" = 20'



ONEONTA BRIDGE NO. 3 -- SPAN 3E

LATEST VISUAL SURVEY OF OCTOBER, 1979

Scale: 1" = 20'



KEY TO MAP SYMBOLS:

Spalls & Delaminations

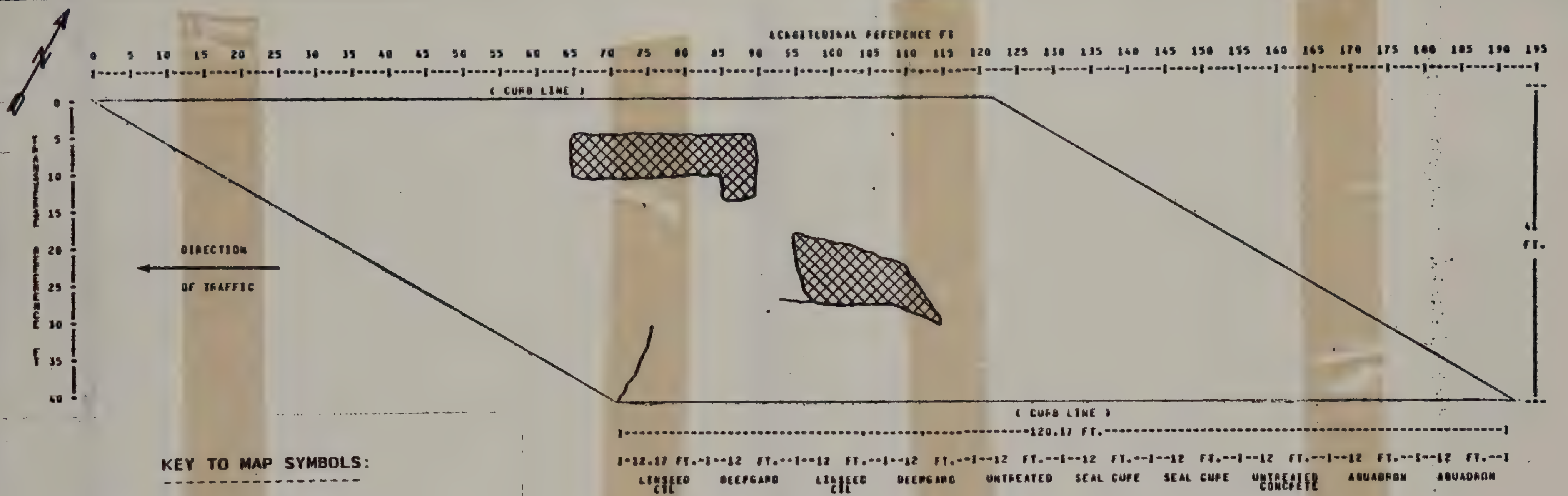
Cracks

Map-type cracks

ONEONTA BRIDGE NO. 3 -- SPAN 2W

LATEST VISUAL SURVEY OF OCTOBER, 1979

Scale: 1" = 20'



KEY TO MAP SYMBOLS:

- Spalls & Delaminations
- Cracks
- Map-type cracks

ONEONTA BRIDGE NO. 3 -- SPAN 3W

LATEST VISUAL SURVEY OF OCTOBER, 1979

Scale: 1" = 20'

Photo #1: Exposed rebar near 120' longitudinal, 25' transverse on Span 2E (Fall, 1979)

Photo #2: Spalled and delaminated area near 100' longitudinal, 20' transverse on Span 2W (Fall, 1979)

Photo #3: Spalled and delaminated area near 100' longitudinal, 25' transverse on Span 3W (Fall, 1979)

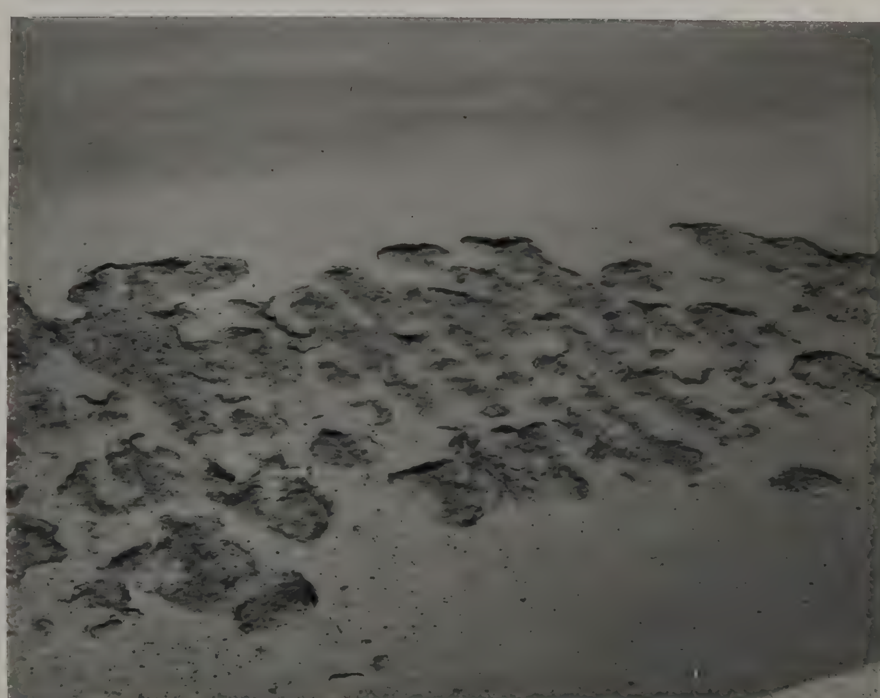


Photo #4: Exposed rebar and spalled area near middle of Span 3W (January, 1982)

APPENDIX I

AADT & SALT APPLICATION DATA

AVERAGE ANNUAL DAILY TRAFFIC (AADT) COUNTS

Date of Count	Direction	AADT One-Way	AADT Two-Way
1974	EB	1820	3860
	WB	2040	
4/75	EB	2150	4570
	WB	2420	
8/75	EB	2860	6830
	WB	3970	
10/75	EB	3530	7020
	WB	3490	
1976	Both	-	7100
5/79	Both	-	8281
7/81	Both	-	6975

SALT APPLICATION DATA

Winter	Number of Applications Per Structure: 10% Salt & 90% Sand (@ 1500#/mi)	50% Salt & 50% Sand (@ 1000#/mi)	100% Salt (@ 300#/mi)	100% Salt (@ 400#/mi)	100% Salt (@ 500#/mi)	Total Salt (lbs) Per Lane Per Structure
74-75	25	-	51	-	-	1220
75-76	48	7	-	15	-	1070
76-77	71	4	-	21	5	1510
77-78	59	-	-	10	3	920
78-79	65	13	-	25	-	1680
79-80	39	-	-	22	4	1065
80-81	51	-	-	31	-	1285
81-82	41	-	-	51	-	1700